CROWN AND BRIDGE-WORK

FOR STUDENTS AND PRACTITIONERS

BY

FREDERIC A. PEESO, D.D.S.

DIRECTOR OF THE DENTAL GRADUATE SCHOOL OF THE UNIVERSITY OF PENNSYLVANIA
PHILADELPHIA

Illustrated with 752 engravings

LONDON
HENRY KIMPTON
263 HIGH HOLBORN, W.C.
AND 40 AND 42 UNIVERSITY AVENUE, GLASGOW
1917

TO MY BEST

FRIEND AND COLLEAGUE

ARCHIBALD C. EGLIN, D.D.S.

IN GRATEFUL RECOGNITION AND REMEMBRANCE

OF THE STIMULUS AND INSPIRATION

RECEIVED FROM HIM

THIS VOLUME IS RESPECTFULLY

DEDICATED

PREFACE.

THE technic of Crown and Bridge-work has assumed far more importance since dentists and physicians have realized the close relation of oral cleanliness to the patient's physical well-being. To secure a full measure of stability with promise of long service, with the restoration of function in mastication and speech, was once considered the aim and end of successful Crown and Bridge-work.

Though all careful dentists appreciate the importance of accurate workmanship in attaining these desirable results, and that these prosthetic appliances should be so designed as to facilitate cleanliness, the announcement that some cases of Crown and Bridge-work which had fulfilled all mechanical requirements had, nevertheless, proved a serious menace to the health of the patient, came as a rude shock to the dental profession.

Errors in judgment or workmanship in repairing injuries to the natural organs, or in treating their many pathological conditions, are usually local, and are readily seen. Recently, attention has been directed to the possibility of serious, even fatal, pathological lesions arising from unseen and unrecognized conditions developed under Crown and Bridge constructions which had been worn with comfort and satisfaction, and apparently were well designed and well made. That they were the cause of the trouble in the unfortunate cases reported was reached only by a process of excluding other probable causes. The proof was furnished by the conditions revealed on their removal and the rapid and complete recovery which followed.

This has prompted the writer to give special attention to this aspect of the subject. The trouble justly complained of is not inherent in Crown and Bridge-work construction itself—it is due entirely to errors of judgment in the selection or preparation of supports or abutments, and avoidable errors in designing and constructing the appliances.

The writer desires to enforce the most exacting care in all preparatory procedures to ensure a healthy condition of the supports and abutments, and thoroughness in the mechanical preparation for all attachments. If these are accurately fitted, and are strong enough for the work demanded of them, and the requirements of occlusion are fully met, he feels assured that the appliances will prove aseptic, durable, and efficient.

In formulating and presenting to the profession the methods found satisfactory in practice in the preparation for and construction of Crown and Bridge-work, he has borne in mind the paramount importance of a well-considered aseptic technic in addition to that required to meet the mechanical problems involved.

A long experience in private practice and in the teaching of this dental specialty has enabled him to select and present methods readily acquired, that produce results quickly and with certainty, if carefully followed. He would add, however, the caution that it requires long and patient practice to thoroughly master the details of operations which, although common to the dental workroom, when applied to Crown and Bridge-work are more exacting, and call for a more skilful use of tools and appliances than when used in constructing ordinary plate work.

The author cannot conclude without expressing his appreciation of the assistance given by Dr. Wm. H. Trueman, and especially Dr. Edward C. Kirk and Dr. A. C. Eglin, whose inspiration, constant interest and encouragement for several years past have been largely responsible for the production of this volume.

He also wishes to express his gratitude to Mr. Christian Febiger, whose patience, courtesy and many kindnesses have done so much to lighten the work.

F. A. P.

New York, 1916.

CONTENTS.

INTRODUCTION.

Although crown and bridge-work has come down to us from remote antiquity, it is only within the last three or four decades that it has assumed an important place in dental prosthetics. In the beginning of this revival, most of the work was done in a haphazard way, with but little or no understanding of the principles involved, and with but little appreciation of its requirements, its possibilities, or its dangers.

The sole idea of the dental practitioner was to give the patient something better than the partial plates then in use, something resembling more closely the lost natural teeth in firmness and in ability to perform their normal functions.

Crude as crown and bridge-work then was, it was sufficiently successful to be appreciated by the community, and to be considered by the profession as promising greater usefulness than the appliances it supplanted. Patients demanded it, and this prompted an earnest effort on the part of many in the profession to discover and remedy its shortcomings. As the result of this, within a few years crown and bridge-work has earned recognition as a specialty in dental science.

As often happens when new things are introduced, or old things are so revolutionized that they enter, quickly, upon a higher stage of development, the limitations of crown and bridge-work were but slowly recognized. The importance of firm and healthy supports, due consideration of the mechanical principles in designing and construction, careful attention to occlusion, and work that was thoroughly aseptic, received but little thought during the early days of crown and bridge-work. As a result the work was usually short-lived, was not cleanly, and the appliance was not always comfortable or effective.

Looking back to this period in the development of crown and bridge-work, viewing the monstrosities inserted by thoughtless enthusiasts as dental bridges, or reading the records of disappointment, failures and disasters, one wonders how the art survived.

That it did survive is due to the unceasing efforts of a few earnest workers who saw its promising future, and by careful study, step by step, traced failures to their source, and unraveled the principles involved in designing and constructing successful, lasting and asceptic, crown and bridge-work. Though the ideal has not been reached, crown and bridge-work has been placed upon a more secure foundation, and a most promising future is unfolded as the result of these labors.

That the crown and bridge-work of the early days was faulty was not due entirely to poor workmanship. Many of the early practitioners were especially skilful workmen, and did excellent work. The trouble lay in the science not being sufficiently developed to enable them to work understandingly, especially in the preparatory work upon which so much depends. Treatment of pathological conditions was not understood and appreciated as it is now. Remedial agents and procedures, now considered indispensable, were then unknown; instruments, appliances and precautionary measures, which have aided so much to make this work effective, were then undreamed of.

Recognition of the underlying principles or factors which make for or against successful bridge-work came slowly. Prominent among these was root and abutment preparation. In a majority of the early cases, we might perhaps say in all, there was no attempt made to prepare the mouth, scientifically, for the reception of the work. The importance of pulp canal cleansing, thorough treatment of pathological conditions, and effective pulp-canal filling was appreciated by a few only, and these were hampered by defective instruments and inability to promptly verify the accuracy of their work. This handicap has since been razed by the introduction of delicate pulp-canal instruments and the marvelous *x*-ray.

Abutment trimming, so important to properly fitting abutment crowns, was often ignored; indeed, until the introduction of properly shaped abrasive wheels and disks, it was practically impossible. The introduction of these useful instruments was a step only, for until it was demonstrated that a devitalized tooth made as good, or even a better abutment than a vital tooth, the intense pain attending abutment trimming too frequently halted the operation before it was complete. The discovery of pressure anesthesia, and other anesthetic processes, making possible the painless devitalizing of a pulp without injury to the tissues around the apex of the tooth, was the last step that made possible scientific abutment trimming, and the construction of an aceptic abutment crown.

Still another fundamental to crown and bridge-work success was brought to the fore when a few scientifically inclined earnest workers, in an effort to make more effective artificial dentures, began a careful study of the various movements of the mandible during mastication. The object of these efforts was to devise a contrivance to accurately reproduce these movements so as to enable the dental workman, when mounting artificial teeth, to secure a more normal occlusion.

Heretofore, if the upper and lower teeth articulated with each other when the mandible was at rest, the work was deemed satisfactory, notwithstanding that the dentures were quite ineffective in mastication, owing to the fact that all the teeth met only when the mandible was in the rest position. At other times but few teeth were in contact. The immediate result of these investigations was a better understanding of the mechanism of mastication, and a higher appreciation of the importance of normal occlusion that has since reached all departments of our profession. By occlusion is understood a rubbing or grinding surface contact of all the masticating surfaces of the teeth, during all the movements of the mandible, as is always the case with the natural teeth in their normal position. Articulation is a mere fitting together in one position only.

This understanding of occlusion brought to the fore an imperfectly recognized cause of failure of many dental bridges. With the mouth closed, the teeth on these bridges fitted the opposing teeth accurately, but during mastication they touched at a few points only. Except for this fact these bridges might have given many years of excellent service, but owing to defective occlusion the force of mastication was concentrated upon a few teeth, which resulted in literally pounding the structure to pieces in a short time. In other cases the stress set up a destructive irritation in one or more of the supporting abutments, which just as surely resulted in the bridge failing.

We now know that it is impossible for any one tooth to be unduly strained during mastication, or other movements of the mandible if the occlusion of the denture has been properly adjusted, be it a plate, a crown, or a bridge.

Crowning of vital teeth proved to be the cause of numerous failures, although at one time a vital abutment was deemed more reliable than one devitalized. After a few years many cases, where vital abutments were used, developed dento-alveolar abscesses, the pulp in the meantime having died as the result of irritation, perhaps from denuding of its enamel when preparing the crown for an abutment cap, or perhaps from irritation due to the cement. In other cases an overstimulation of the pulp produced secondary dentin deposits, pulp stones, and other kindred troubles.

It was quite a step forward when the profession recognized that the pulp was a formative organ, and that when its work was done, it was no longer necessary to the life and health of the tooth. Also when a technic was developed by which the pulp could be removed painlessly and its place occupied by an inert substance, with but little risk, if any, that the tooth would ever become a source of trouble as the result of its devitalization.

Until within recent years but little thought has been given to the stress of mastication, the force developed by the muscles moving the mandible, and the force required to properly perform the function of mastication. Until this information was available, designing a bridge to withstand this force year after year was mere guess-work. Too often the stress of mastication and the strength of the bridge or its abutments was grossly underestimated, and failures thereby invited. We now know that ample strength must be provided, and we know also, approximately, the relative strength or carrying capacity of the different teeth when used as abutments. This is another forward step, and an important one.

There is still another point, recently impressively brought to the fore, and a very important point it is. A very serious charge has been brought against crown and bridge-work by our medical brethren. They claim that as generally designed and constructed, crown and bridge-work is often a serious menace to the patient's health. That many serious ailments have been caused and maintained by septic conditions associated with crown and bridge-work often worn by the patient with great comfort and satisfaction. The proof presented is so strong and convincing as to challenge investigation, and prompts the question, Why?

This brief resumé of the progressive development of crown and bridge-work will no doubt have suggested to the thoughtful reader the answer to this important question, and may, perhaps, have suggested another. Why was not this discovered earlier, when the art was crude, and the work in all its phases more imperfectly done?

Medical science has made a marvelous advance during recent years in tracing pathological lesions to their causes. Many disorders that were formerly treated with indifferent success, by methods suggested by the symptoms developed, are now recognized as pathological conditions due to remote causes, causes at times located far from the seat of trouble, and seemingly to the unscientific observer, having no connection whatever with it. The cause recognized and removed, the disease is cured.

This has been the case in many instances to wearers of crown and bridge-work. They have suffered, in some cases for years, with but little relief until the medical attendant was led to suspect that septic infection was the real cause. A careful, step-by-step diagnosis by exclusion has located this in a highly priced piece of bridge-work,. a masterpiece of prosthetic dentistry. Its removal has disclosed a horrible condition of affairs. A judicious use of the forceps and oral prophylaxis, followed by a rapid cure, proved the diagnosis correct.

In order to purge crown and bridge-work of any possible stigma now resting upon it, our profession must make practical use of the knowledge gained by experience, and that furnished by the research and observations of our medical brethren. No half-way measures will suffice. It must be made aseptic from the foundations up. All pathological conditions must be thoroughly and radically treated, and the treatment continued until a cure is effected and all sources of septic invasion removed.

In comparing the general output of crown and bridge-work as we see it today with that of the past, there is not that marked difference in its character we have a right to expect, considering the tremendous advances which have been made in our knowledge of the physiology and pathology of the dental pulp, and the technic of root and pulp-canal treatment. This is really where the trouble is. This knowledge has not been utilized as it should have been in making crown and bridge-work better and safer.

Modern methods of treating such pathological conditions as have been responsible for the undoing of crown and bridge-work are radical, and radically different from those which have prevailed in the past. Pulp and pulp-canal treatment as it should be done when preparing for crown and bridge-work is tedious, it takes time, it requires patience and exacting care to make sure that it is well done. The mechanical preparation of roots and abutment teeth, as we now know they must be prepared, is very different from the slipshod methods of the past. It is regrettable that these matters have not been generally realized. Had this specialty correspondingly developed with the development of our knowledge of the various technical procedures underlying the scientific construction of bridge-work, we should have so improved the character and efficiency of the average output of bridge-work, as to have made it beyond all comparison better than the bridge-work of the past.

In order that these results may yet be accomplished by the means already at our command, it is necessary that we give earnest attention to, not only the underlying principles upon which all good bridge-work is founded, but also sympathetic and careful attention to the infinite number of minor as well as major details, both technical and artistic, which are collectively necessary to the attainment of excellence in this and in all things which are worth doing well.

CROWN AND BRIDGE-WORK.

CHAPTER I.

ARTIFICIAL CROWNS.

WHEN the natural crown of a tooth has become broken down or decayed to such an extent that it is impracticable to restore it by means of fillings or inlays it becomes necessary to resort to some other means of restoration to enable it to perform its normal function. This is done by means of an artificial crown.

There are three types of crowns which are used for this purpose, differing from each other chiefly in the manner of their retention, the first type being retained in position by means of a pin or post inserted into the enlarged pulp canal. The second is held in place by means of a collar or band which encircles the stump of the tooth. The third is a combination of these two, having both a band and post to give the necessary support.

The first of these is used almost exclusively in the teeth anterior to the molars. The second is confined almost wholly to the molars but at times is used as far forward as the bicuspids and under certain conditions for the anterior teeth. The third is used principally in the anterior teeth, but is also at times indicated in the posterior teeth.

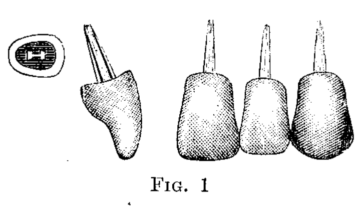


FIG. 1

There are two classes of this first type of crown; one being that in which the post is an integral part of the crown itself, being baked into the porcelain or soldered to it (Fig. 1). In the first class we have the Logan crowns and the pin and post crowns. The second class is one in which the crown and post are separate, there being an opening in the base of the crown or entirely through it in which the post is cemented or otherwise fixed (Figs. 2 and 3).

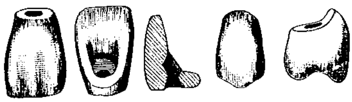


Fig. 2

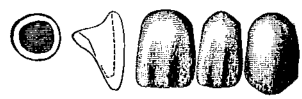


Fig. 3

Examples of this class may be found in the Bonwill crowns, Davis crowns, Justi crowns, and the English tube teeth.

There is little choice between the different crowns of these types. That which best meets the requirements of a given case in mold, shade and texture may be chosen.

There are also two classes of the second type of crown. The first is used exclusively in the back of the mouth, being made entirely of metal and is represented by the gold shell crown. The second class is a combination of both metal and porcelain, having a band for retention, but the exposed portions, the face or occlusal surfaces being covered with veneers or porcelain. An example of this class may be seen in the jacket crown.

In the third type we have the so-called Richmond crown, or a crown with a Richmond base and an all porcelain crown attached to it.

These different types of crowns are used as single crowns, or as abutment crowns, or dummies in bridge-work.

ESSENTIALS TO SATISFACTORY BRIDGE-WORK.

General Considerations.—When consulted regarding the advisability of inserting a piece of bridge-work, there are three fundamental factors to be considered: the number, position, and condition, of teeth or roots available as abutments. The whole story of requirements for this work may be summed up in these three words. If the available teeth or roots are lacking in number, or are unsatisfactory as to position or condition, an essential to success is wanting, and the work is contra-indicated.

There are certain mechanical and scientific principles governing this work and these same principles are involved whether we are placing a bridge in the mouth or across a river. There must be sufficient number of abutments to carry the weight which will be imposed upon it, and their position and condition must be such as to give stability to the structure, and to withstand any strain to which it may be subjected, otherwise it will collapse.

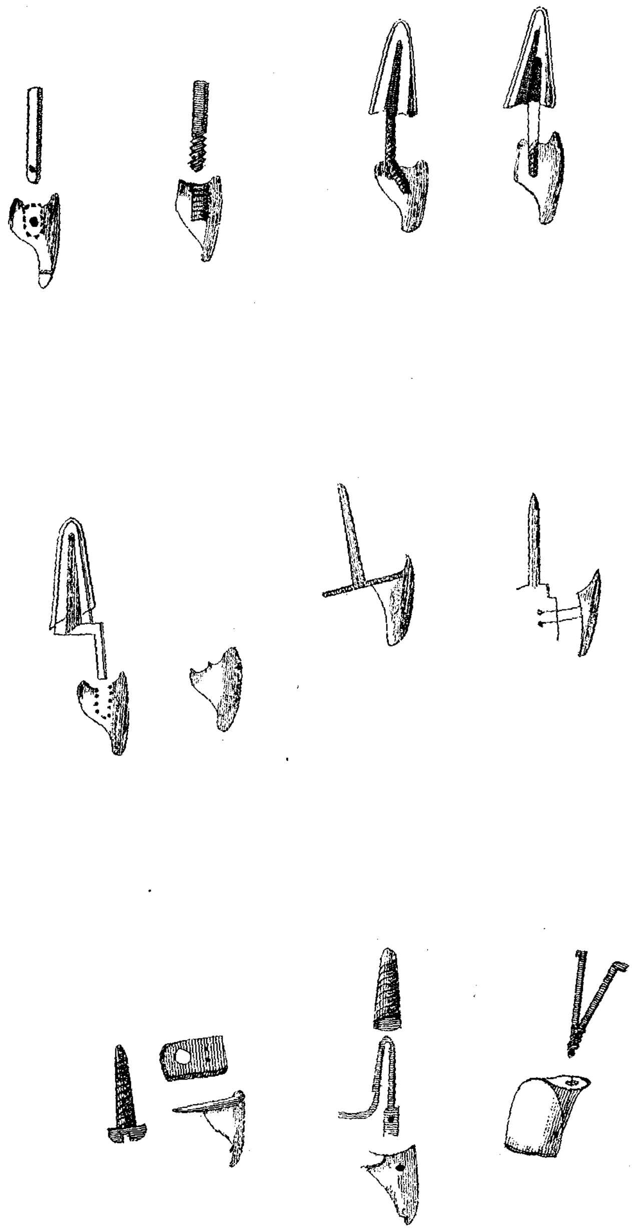
Partial Plates vs. Bridge-work.—In a very large percentage, probably in the majority of mouths where partial plates are now worn, bridge-work could be used to much better advantage, and would be far more serviceable than are the plates. Partial plates are always decidedly objectionable and are to be avoided if possible. The plates, almost invariably injure the soft tissues and the adjoining teeth, the pressure gradually forcing the gum away from the necks of the teeth, which are abraded by the constant movement of the plate, and in many instances this results in their loss. This is especially true where the plate is of small dimensions, carrying but one or two teeth.

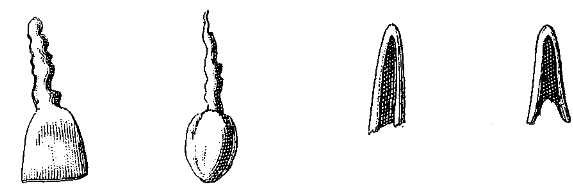
In every case, or at least all but the simplest, it is best to take plaster impressions of the mouth and make accurately articulated models, trimmed so that they may be examined from every point of view, both from the inside as well as the outside. These models should be studied carefully before deciding on any definite line of operation.

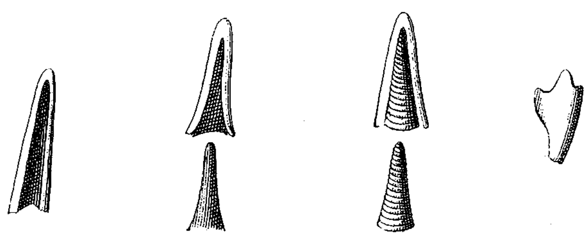
The number, position, and general condition of the teeth being satisfactory, the success of a crown, or of a bridge, depends entirely upon the preparation of the teeth, or roots, which are to serve as abutments. By this preparation is meant not simply the mechanical trimming of the teeth or roots for the reception of the bands or posts, but it begins at the beginning with the treatment of any pathological conditions which may be present, the devitalizing and removal of the pulp, and the sterilizing and filling of the canals. This will be considered in the succeeding chapter.

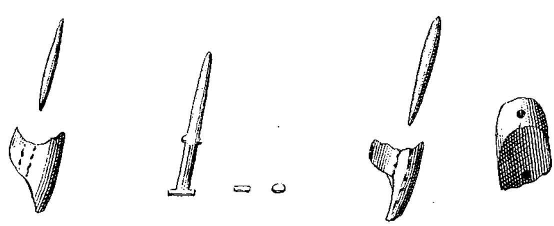
The accompanying illustrations (pages 20 and 21) are accurate reproductions from *Traité de la Partie Mécanique de l'art du Chirurgien-Dentiste*, par C. F. Delabarre, published in 1820. They give a very good idea of the crown work which was done at that time.

We are enabled to reproduce these figures through the kindness of Dr. E. J. Ranhofer, of New York.









CHAPTER II.

PATHOLOGICAL CONDITIONS IN THEIR RELATION TO CROWN AND BRIDGE-WORK.

It is not the intention of the writer to consider the treatment of pathological conditions except as they are directly related to crown and bridge-work. Inasmuch, however, as a healthy condition of the teeth and roots utilized as supports for crowns and bridges is a fundamental to success, pathological conditions of the teeth and their treatment, is of the utmost importance to crown and bridge-workers.

Each factor making for success or failure must be carefully considered, and nothing left to chance. Loose teeth need not necessarily preclude the idea of inserting a bridge; they should be carefully studied in order to determine the cause, and whether or not they can, by thorough treatment, be brought to a normal, healthy condition. If this is impossible, then, of course, unless other teeth are available, a crown or bridge is not to be thought of.

Loose Teeth.—Looseness of teeth may be brought about by many causes, such as pyorrhea alveolaris, dento-alveolar abscess, kidney troubles, malocclusion or want of occlusion, etc. Some of these causes may require the services of a physician, those due to faults of occlusion, and many others, will usually yield to thorough dental treatment. Nothing should be done, however, until the cure is effected and the teeth have become firm.

Pyorrhea Alveolaris.—A case of pyorrhea, if it be serious, is generally better referred to a specialist, as one specializing in this particular branch, will probably get better results than another who treats it only occasionally.

In its earlier stages a cure may be effected by thorough instrumentation, and cleansing the parts affected with antiseptic solutions. The affected teeth, when the disease is well advanced, are generally useless as supports for crowns or bridges.

Pyorrheal Conditions.—Conditions are frequently met with in the oral cavity resembling pyorrhea which are not really this disease.

They may be caused by some local irritation, such as ligatures forgotten, and left around a tooth, below the gum margin, causing irritation resulting in infection, and a flow of pus. The same effect may be brought about by a splinter, as from a tooth pick, or some such like irritation. These cases may, at first sight, be mistaken for pyorrhea. The removal of the cause usually effects a cure.

Putrescent Pulp Canals.—In treating a putrescent pulp canal the first step is to cleanse it mechanically, as thoroughly as possible. The greatest care must be exercised in doing this so as not to force any of the putrescent matter or gas through the apical foramen. The instruments best suited for this purpose are the Donaldson canal cleansers. These instruments are barbed in such a manner that the barbs follow around the shaft in the same manner as does the thread on a right-hand screw, so that by rotating the instrument is drawn into the canal without the necessity of using the slightest force.

The instrument is dipped in carbolic acid or other strong antiseptic, the point placed in the canal and the instrument turned slowly to the right. As it is carried into the canal it is frequently withdrawn and cleansed of the matter adhering to it, until the vicious matter is entirely removed. By working in this manner there is no danger of carrying any of the putrescent mass through the end of the root. It is of the greatest importance that not the slightest force be used on the instrument. After the bulk of the softened mass is removed, the sides of the canal are scraped with the same instrument, until it is fairly well cleansed.

Sodium and potassium, or sodium dioxide, is then used, being carried into the canal with a fine instrument, burning out any of the disintegrated pulp tissue which remains in the root. This should be done thoroughly, and a little of the sodium and potassium left in the canal until a subsequent sitting. When the patient returns, the treatment with the sodium and potassium is repeated, after which the canal should be washed out with a solution of bichloride of mercury and peroxide of hydrogen. The canal is then thoroughly dried and filled.

In the absence of the sodium and potassium, or sodium dioxide, formalin may be used, but this should not be sealed in the root, unless the foramen is closed, or is very minute, as it is an active irritant and may cause considerable pain and trouble.

Sterilizing a Pulp Canal with Formalin.—In sterilizing a pulp canal with formalin, the following method will prove effective. After the root has been as thoroughly cleansed mechanically as is possible under the existing conditions, it is dried with alcohol and the canal wiped out with a strong solution of formalin, running from 10 to 40 per cent. the full strength of the solution, using a wisp of cotton twisted around a broach as a carrier. It is then dried with hot air or a heated root-drier, thereby driving the formalin into the tooth structure. This operation is repeated a number of times until it is certain that the root has been thoroughly sterilized, after which it may be filled.

Where there has been a slight irritation in the apical region, it is a good plan to enlarge the foramen very slightly before treating, and a dressing of tricresol and formalin may be sealed in the canal and left for a day or two, to be repeated if necessary.

Where there has been an excessive and continued irritation, it is best to treat the case in a thorough manner, opening through the process to the apex, giving it the same treatment indeed, as in the case of a dento-alveolar abscess, and then filling the root at once.

When on opening into a tooth, if the pulp is dried up and in a mummified condition, the canal should be given the same treatment and care as though the pulp was putrescent.

The same treatment should be employed in the case of cotton filled roots, which are sometimes met with, without regard to the condition they may seem to be in, foul or sweet. In a majority of these cases the canals are in a putrid condition, and before being utilized they should be treated as advised for the canals of putrescent pulps.

PULP INFECTION AND TREATMENT OF RESULTANT CONDITIONS.

There are many causes which may bring about the death of the pulp and unless this condition is recognized very early and properly treated, trouble of a more or less serious nature is liable to follow.

There are cases where the pulp has become devitalized and remained quiescent for a number of years, the patient being unaware that there is anything wrong with the tooth, but this is not of frequent occurrence; more frequently the trouble becomes manifest within a comparatively short time.

With the infection and decomposition of the pulp tissue, the danger begins. A minute portion of this putrescent matter, or a little of the gas generated by it, finding its way through the apical foramen will set up an irritation and inflammation; infection follows, resulting in the formation of a dento-alveolar abscess. This condition is too often lightly considered, and an abscessed tooth looked upon as of minor importance, when in reality it is a grave condition and may cause serious pathological disturbances, and not infrequently death has followed from septicemia caused by resorption of pus.

Dento-alveolar Abscess.—This is one of the troubles with which the crown and bridge specialist is most frequently confronted. As a general thing, it is also one of the easiest to cure.

In this as in every step in crown and bridge-work, thoroughness is necessary to success, and unless one is willing to give the time and attention necessary to effect a cure, it is far better not to attempt its treatment.

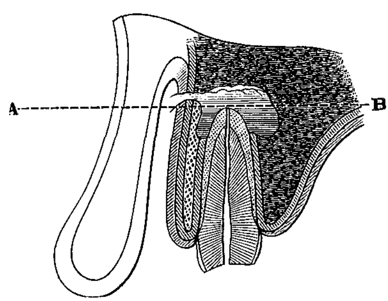


FIG. 4

With the formation of pus around the apex of the root, there is a destruction of tissue extending in all directions, thus forming an irregular cavity or sac into which the apex of the root extends (Fig. 4).

As the amount of pus increases, it will gradually force its way through the alveolar process and gum tissue, thus establishing a fistula.

If there is a cavity in the tooth through which the pus, after passing through the canal, may be discharged into the mouth, there will be no external fistula; this is termed a blind abscess.

The treatment of an abscess which has no outlet for the pus excepting that through the root of the tooth, should never be undertaken. It is practically impossible to force the remedies through the apical foramen into the pocket or sac of the abscess, or to cleanse it thoroughly and remove the debris without having an external fistula. Treatment through the root may relieve the trouble temporarily, but it is liable to recur at any time.

In the case of an acute dento-alveolar abscess, where there is a fistula established, a cure can generally be effected quickly and easily. It is not necessary to have the patient make daily visits, as with proper care it is very rarely that it is necessary to give it more than one, or, at the most, two treatments, in order to effect a permanent cure, but in doing this, every step of the operation must be done thoroughly.

For many years the writer has had almost uninterrupted success in the treatment of this trouble by using the following method:

The canal is first cleansed as thoroughly as possible mechanically, using Donaldson's canal cleansers, or instruments of that type, and scraping the sides of the canal thoroughly so as to remove every particle of diseased tissue which can be reached.

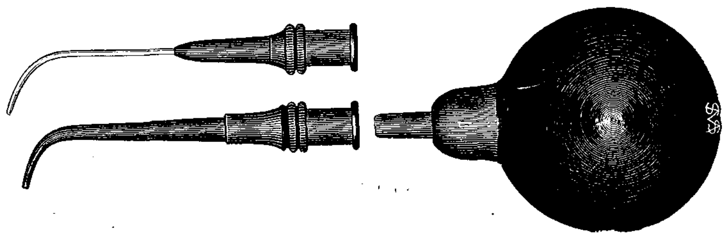


FIG. 5.—Bulb syringe.

It should then be ascertained beyond doubt that there is an open fistula, through which the remedies will readily flow, and this can be done by using distilled water or a mild antiseptic solution, after which the first agent used is hydrogen peroxide.

Objections have been strongly urged against the use of this agent, the claim being much that it will cause necrosis and sloughing, but during the experience of twenty-five years, the writer has not had a single case where this has occurred. If the peroxide were forced into a closed sac under pressure, then serious trouble might ensue, but where there is a free vent there is, practically, no danger from its use.

Treatment of Acute Dento-alveolar Abscess.—In the treatment of acute dento-alveolar abscess it is necessary that suitable instrument for injecting the remedies be used. A rubber bulb syringe, with platinum point, known as an abscess syringe is most useful for this purpose (Fig. 5). The capacity of the bulb of this syringe is one-quarter of an ounce.

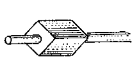


FIG. 6

In order to insure the remedy being forced through the canal and out through the fistula, it is necessary to use a packing, preferably of rubber. This is very easily made by forcing the needle through a piece of heavy separating rubber, of sufficient size to entirely cover the opening in the tooth or root, letting the end of the needle extend a little beyond this rubber packing, as in Fig. 6.

The point is then introduced into the opening in the canal or tooth and the rubber pressed tightly over the opening and around the needle with a pair of cotton-pliers. This will effectually prevent the fluid from escaping at this point, and will insure its reaching the place where it is needed.

The abscess is first washed out with sterile water so as to ascertain that there is a free vent, then hydrogen peroxide is forced very slowly through the root and out of the fistula, and this is continued as long as there is any effervescence. It is sometimes necessary to use a large amount of the peroxide before the pocket is entirely cleansed. At times one or two ounces or even more may be required, but it should be continued until the solution comes through perfectly clear.

The hydrogen peroxide is followed by the standard solution of aromatic sulphuric acid. This solution is used in its full strength as given in the United States Pharmacopeia and contains about 10 per cent. by bulk, or 20 per cent. by weight, of sulphuric acid.

The amount of the aromatic sulphuric acid used is from one-quarter to one-half of a syringeful, or from one-sixteenth to one-eighth of an ounce, or at times even more than this.

The point of the syringe is inserted into the canal and the rubber packing pressed tightly against the tooth, as with the hydrogen peroxide, and the acid forced through very slowly. This helps to destroy any remaining diseased tissue and acts as a stimulant. The acid should be met, as it comes through the fistula with a syringe full of a saturated solution of bicarbonate of soda, so as to counteract, or neutralize, the action of the acid before it comes in contact with the teeth and the soft tissues of the mouth. The bicarbonate of soda should be used freely, as much as three or four syringe fulls during the injection of the acid, and afterward the mouth should be rinsed freely with the same.

After the acid has been used, the root should be filled at once. If it is left open for any length of time, infection may recur, and it will be necessary to repeat the operation as there is a serious risk of reinfection as long as the root remains open.

After treating an abscess in this manner and filling the root canal, it will generally require from ten days to two or even three weeks before the parts are finally healed. During this time there will be a discharge of blood and serum through the fistula, presenting the appearance of pus, but this is a perfectly natural condition, as there is a normal sloughing of the disintegrated tissues which must be expelled as the parts are healing.

At times, when the edges of the wound are fresh, the fistula may close up at once, or within two or three days, but it will break out again, and this may be repeated several times; it will not heal finally until all of the sloughed tissue has entirely disappeared and healthy granulations have replaced it.

It is very rarely, in the case of an acute abscess, that it is necessary to repeat this treatment, but it should be remembered that the cure depends entirely upon the thoroughness with which the operation has been performed.

Establishing a Fistula.—If there is no external opening, and the abscess has been draining through the pulp canal of the tooth, it is necessary to establish a fistula. Occasionally, by sealing the opening through the tooth for a time, nature will establish one with comparatively little discomfort to the patient, but if this cannot be done, it becomes necessary to make an opening through the gum and process.

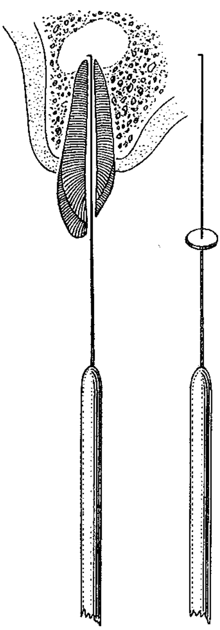


Fig. 7

A spear-pointed drill is best suited for this purpose; it should be of a large size, sharp, and perfectly sterilized.

Locating the Apex of the Root.—It is necessary to first locate the apex so as to know exactly where to drill. The foramen is slightly enlarged in order to ascertain the exact length of the tooth or root. This can be done with a small hooked broach, passing it through the canal and catching the hook over the end of the root. A small piece of rubber dam is pressed down over the broach to the incisal edge of the tooth or against the end of the root (Fig. 7). The broach is then removed. The position of the rubber indicates the exact distance from the end of the root or the incisal edge of the tooth to the apex. A perfectly straight broach is then inserted, being of a larger size than the one used in measuring the length of the root, one that will wedge in the canal with the end passing through the foramen into the pocket, the handle extending beyond the incisal edge of the tooth, as in Fig. 8, *a*. By following the line of this broach the exact direction of the canal is indicated.

By placing the hooked broach over the gum and bringing the piece of rubber dam even with the incisal edge of the tooth, or with the end of the root, it will show exactly how far from the incisal edge to drill in order to strike the pocket or the end of the root (Fig. 8, *b*).

Using these two as a guide, and following the direction of the broach which is wedged into the root, the drill can be directed so as to reach with certainty the apex. This operation can be quickly and easily performed by using a general anesthetic, but it is very rarely that a general anesthetic is indicated, as the time required is so short that a local anesthetic, used hypodermically, will give satisfactory results.

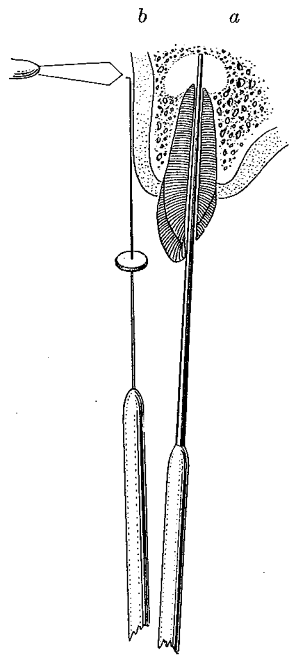


FIG. 8

Painless Insertion of the Hypodermic Needle.—With patients who are of a highly nervous temperament, or where the tissues are extremely sensitive, the pain caused by the insertion of the hypodermic needle is at times almost as great as would be the pain of the operation if it were performed without an anesthetic. The pain caused by the forcing of a hypodermic needle into the soft tissue may be greatly lessened if, when the syringe is filled, the flattened side of the point of the needle is pressed tightly against the gum and the end of the finger pressed over the point, at the same time pressing on the plunger. It is held thus for a moment and gradually the needle is forced into the tissue, the pressure on plunger being kept up all the time. In this way the tissues are anesthetized in advance of the needle, and the operation rendered almost painless. The gum should be first cleansed and dried with alcohol and it is well to touch it with iodine before attempting to insert the needle.

The opening through the gum to the process can be made with a lance, a trephine, or by using a sharp spoon-shaped excavator; with the latter, by dipping it in carbolic acid and scraping the gum a little bit, then dipping in the acid again and repeating this operation until the process has been reached. It is possible thus to go through the tissue to the process without drawing blood, and causing very little or no pain to the patient.

It is possible to take a drill, with the edges of the blade very sharp, and drill directly through the gum, but unless the edges of the drill are very sharp, there is danger that the gum tissue may be caught, and twisted around the drill, and badly torn. The use of the lance is the quickest and easiest method, making a straight incision on a line with the long axis and over the apex of the tooth, or, if it is desired, a crucial incision may be made.

The point of the drill is placed over the apex of the root as indicated by the broaches which are serving as guides.

The engine should be run very rapidly and the aim be to strike the end of the broach which is wedged in the root canal, at about the point where it emerges through the foramen.

Some operators, especially among the younger practitioners, are timid and dread performing an operation of this kind, but it is very simple and is quickly done, not requiring more than a few seconds at the most.

As soon as the pocket is entered, a fistula is established through which the remedies can be forced freely.

Chronic Dento-alveolar Abscess.—When an abscess has become chronic, extending over a period of several years, a necrotic condition in the apical region is established, and a portion of the root will also be necrosed. This necrosed area must be entirely cut away and the diseased portion of the root removed in order to effect a cure.

Treatment.—The apex is located in the manner already described. The incision in the gum should be larger than where simply establishing a fistula. It should be at least one-half inch in length. A large spear-pointed drill is first used and is followed by a large coarse rose or pear-shaped bur to enlarge the opening through the process and bur away the necrosed bone. The necrosed bone must be entirely removed, and during the operation, frequent examinations should be made with an explorer or excavator, and the burring continued as long as there is the slightest trace of necrosed tissue. This can readily be determined by the sense of touch. The necrosed bone has a coarse or honey-combed texture, readily recognized by the instrument, while the healthy bone is smooth in comparison.

After the diseased tissue is entirely removed, the wound is washed out with sterile water, and is then given the same treatment as already described in the case of an acute abscess using hydrogen peroxide and aromatic sulphuric acid, after which the root is filled at once.

Amputation of the Root End for the Relief of Dento-alveolar Abscess. —In amputating the apex of a tooth root, some operators advise the use of a fissure bur, cutting straight across the root, thus removing the end in one piece.

In the writer's opinion, this is an error, as the piece is left in the pocket and at times the part cut away is so large that it can only be removed by greatly enlarging the opening through the process. If it is not removed it will act as an irritant and there will be a recurrence of the trouble.

A large rose bur or pear-shaped bur is indicated for this work, starting from the apex and burring away the root gradually as far as is necessary, the root is thus reduced to fine particles which are easily washed out from the pocket. The after-treatment is the same as that for an acute abscess.

Many operators prefer filling the root before amputating. When this is done, the filling is burred away with the root. With this method, there is always a possibility of loosening the root filling, and thus leaving a chance for future trouble.

The writer believes that in an operation of this kind, the most satisfactory and certain method is to fill the root after amputating. The length of the root is taken with a hooked broach, and a canal plugger is selected which will reach only to within about one-eighth of an inch of the end, the same as in the filling of a root with an enlarged foramen.

The pocket is first treated the same as for an acute abscess, being washed out with hydrogen peroxide, followed with aromatic sulphuric acid.

An instrument having a broad flat end is passed through the opening in the process and pressed tightly over the end of the root, being held firmly in that position with the left hand. The canal is then thoroughly dried.

A gutta percha point, which has previously been selected and which is slightly larger than the plugger which is to be used, the length being about that of the canal between the end of the plugger and the end of the root, is fastened to the plugger point by heating. This is dipped in eucalyptus oil and packed tightly against the instrument which covers the end of the root. By filling the root in this way, we may be quite sure that the filling is firm, and there will be no liability of leakage.

If the crown of the tooth is good, and the canal is not to be used for the reception of a post, the entire canal may be filled with the gutta-percha, packing it tightly against the instrument covering the end of the root.

If the wound is large, it is better that it be packed lightly with antiseptic gauze, which will act as a seton and keep the part drained. This dressing should be changed every two or three days and the wound washed out with an antiseptic solution. Healthy granulation will quickly begin and the depth of the wound will diminish as it is filled in with healthy tissue. The treatment should be kept up until the wound has become filled with healthy tissue to within about one-quarter of an inch of the opening. The dressing and washing may then be discontinued. Healing will be complete within a very short time, if all of the necrosed tissue has been removed. If this does not take place, it is evidence that there is still remaining some diseased tissue, and further treatment, looking to its removal, is needed.

CHAPTER III.

CROWN AND BRIDGE-WORK IN RELATION TO THE VITALITY OF THE PULPS IN SUPPORTING TEETH.

For many years it was a question as to whether it were best to devitalize a tooth preparatory to crowning, or to preserve the pulp alive. There was rarely held a dental meeting of any importance where this subject was not discussed. Much was said both for and against devitalizing, some claiming that the pulp should always be retained wherever it was possible, devitalizing used only as a last resort, while others held an opposite opinion.

The writer himself, at the beginning of his work, considered it almost a capital offence to destroy a pulp if there was any possible way of retaining it and still utilizing a tooth as an abutment.

After a time, however, it was found that the teeth from which the pulps had been removed were doing as good work, or even giving better results than those, in which the pulps had been preserved.

The excessive irritation caused by removing the enamel (which was necessary in order to have a closely fitting band) and also the irritation caused by cementing the piece in place seemed to excite an overstimulation of the pulp, resulting in the deposition of secondary dentin, the formation of pulp-stones, and kindred troubles.

It is generally recognized at the present day, that the pulp is purely a formative organ, and after it has performed its function it is no longer necessary to the life and health of the tooth, and a tooth from which the pulp has been removed and the canal has been properly filled will do the work as a support for a bridge as well or even better than one in which it has been retained.

Exceptions.—There are a few exceptions to this rule. In the case of a patient of advanced years, where the tooth has been broken or worn down by attrition, so that it can be trimmed or shaped with little or no pain, or where the pulps of the teeth may have receded to such an extent that the canals have become nearly obliterated, it is permissible, and many times advisable, to crown such teeth without undertaking to devitalize.

In the case of very young subjects the teeth should never be devitalized for the purpose of placing a shell crown or a bridge, as the teeth are not then fully developed, and the pulps should be retained until the patient has matured and the roots are perfectly formed. It is rarely that pulps should be devitalized until the patient is at least seventeen or eighteen years of age.

In the case of a very young subject, where teeth have been lost and the patient, perhaps, has been under orthodontic treatment, and it is necessary to bridge the space in order to retain the teeth in proper occlusion, a temporary bridge may be made, mutilating the teeth as little as possible, simply making space enough between those which are to serve as abutments and adjoining teeth to allow for the thickness of a metal band, but not cutting through the enamel. After the work has been placed in the mouth, it should be frequently examined and a careful watch kept over the patient until such time as it may be advisable to insert a permanent fixture.

THE CAUSE OF SOUND TEETH DISCOLORING AFTER DEVITALIZATION.

There are times when a patient may object to having one of the anterior teeth devitalized for fear that it may become discolored. If the operation of devitalizing, and the after-care of the tooth has been properly done, there will be no discoloration. The discoloration of a tooth from which the pulp has been removed is due not to the fact that the tooth has been devitalized, but to its improper treatment after devitalizing.

Quoting from his own experience, the writer does not recall a single case in which a tooth has become discolored after removing the pulp, but he has seen and treated many such cases, and has invariably found unmistakable evidence of the manner in which this condition was brought about.

The tooth is opened from the lingual or palatal side, or through a cavity, perhaps, on the mesial or distal side, drilling in the direction of the apex. The pulp is removed through this opening and the canal cleansed and filled. Usually it will be found that this part of the work has been well done, but the operator has not gone far enough in his work to prevent the trouble. As will be seen in the illustration (Fig. 9), the horn of the pulp extends far up into the crown of the tooth, while the opening has been made far below it. The result is that this extension of the pulp remains in the tooth after the canal and cavity has been filled, as in Fig. 9, where it decomposes, and in time the tooth structure becomes infiltrated with this putrescent matter causing the discoloration.

The writer does not remember, and has no record of ever having opened up a discolored tooth where he has not found the conditions as described above.

After the canal has been opened, the pulp chamber should be enlarged sufficiently near to the incisal edge of the tooth to permit of the removal of every particle of pulp tissue. This can be done with a rose bur in the right angle hand-piece, working from the lingual side, and opening it up enough so that the extreme apex of the pulp chamber can be reached, Fig. 10. After the pulp has been entirely removed, the cavity is thoroughly sterilized and filled with cement of any suitable color.

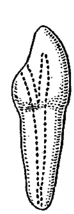


FIG. 9

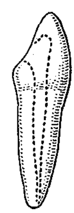


FIG. 10

Although, if the work of devitalizing and filling a tooth be properly done, there will be no discoloration of the crown, there will always be a slight difference in the opacity, owing to the removal of dentin and the placing of the cement lining which may render it slightly noticeable in certain lights, or when viewed from certain angles. This will be especially true if the tooth so treated is standing next to its mate, as would be the case if one of the centrals was devitalized. With the cuspid, there are so many teeth between it and the corresponding tooth on the opposite side of the mouth, that even a marked difference in color would not be in the least conspicuous. The following may be set down as a rule which should invariably be observed.

Where there is a choice of teeth, one of which is to be devitalized to serve as an abutment for a bridge, *always devitalize the tooth which stands farthest away from its mate.*

In the case of a lost lateral, the cuspid and central being in equally good condition, the cuspid should be used as the abutment, but if the central incisor is badly decayed or broken, then of course it will be policy to utilize it.

DEVITALIZATION OF THE PULP.

When it is found necessary to devitalize the pulp of a tooth prior to its preparation for an artificial crown, there are several questions to be considered. The first of these is: In which of the methods that may be employed is there the least danger of irritation or injury to the tooth or its adjacent parts? (2) In what way may the operation be performed with the least pain to the patient? (3) How can it be most quickly and easily accomplished?

Arsenic.—There are several methods and agents employed for the devitalization of the pulp, any of which may be indicated under certain conditions. Among the agents that are generally used for this purpose, arsenious acid has been longest in use and more generally employed. It is the one, however, which requires the greatest care in its use; is dangerous in unskilled hands, and is not always certain in its action.

Dr. Herman Prinz's Method.—Innumerable formulas for compounds of arsenic with other drugs are suggested for dental purposes. The principal object has always been to combine the arsenic with an anesthetic. If the pulp is in a normal condition, very little or no pain is manifested by the arsenical application; if the nerve cells are inflamed or are undergoing necrobiotic changes, the increased irritation brought about by the powerful oxidation and reduction as a result of the pharmacologic action of arsenic increases the already existing neuritis and more or less severe pain results. Arsenic is very diffusible; it quickly destroys the nerve endings, and consequently there is little chance for the anesthetic which may be added to it to exercise its specific function. For this very reason it is questionable if the addition of a local anesthetic is of any benefit.

A more rational procedure consists in applying to an aching pulp a concentrated solution of a local anesthetic-cocaine, novocain, etc., prior to the introduction of the arsenical paste. Tanning agents are frequently added to the paste for the purpose of changing the pulp tissue to a leathery material, so as to facilitate its ready removal.

Tannic acid or the various forms of formaldehyde are useful for this purpose. It is better practice to apply such agents after the arsenic dressing has been removed; the less we interfere with the absorption of the arsenic, the better and quicker will be the results.

As a vehicle for the paste, only such media as are more or less solvents of arsenic, and which allow ready absorption by the pulp, are justified. Glycerin is preferable to any other medium. Lanolin, a natural wool fat, has been recommended; it, however, prevents the ready absorption of the paste. Phenol, creosote, or the essential oils, and similar liquids, have been used for many years as vehicles for the paste; their influence on the action of arsenic is apparently of very little consequence; they certainly do not exercise their typical pharmacologic action in this connection. Strong coagulants should not be used, as they hinder the ready absorption of the poison by forming a scab.

To give a distinct color to the paste, very small quantities of carmine or lampblack may be added. Some practitioners prefer to apply arsenic in the form of a paste mixed with cotton fibers, or in the form of paper disks saturated with a soft paste. Arsenical fiber is prepared by mixing cross-cut cotton with the paste, and the disks are made by saturating very small squares of hard white blotting paper with the thin paste, which are then dried and preserved.

Prior to the application of arsenic, the cavity should be excavated, and if possible the pulp should be thoroughly depleted, either by puncturing the organ or by producing artificial anemia. Szabo recommends lavage for this purpose—washing the pulp with luke warm water, changed slowly to cold water. Quicker results are, however, obtained by applying adrenalin chloride solution under pressure.

The cavity must be free from blood, to prevent the formation of inactive arsenic hemoglobin. If the pulp is inflamed and painful, it is absolutely necessary to apply suitable remedies to relieve the conditions before the paste is applied; an inflamed pulp materially hinders the ready absorption of arsenic, and continuous servere pain is certain to follow. A mixture of tannic acid, cocain hydrochlorid, and liquid phenol is serviceable for this purpose. These remedies, if sealed into the cavity, usually alleviate the condition in from twenty-four to forty-eight hours.

If pus is present, it must be drained off, and washed away with a mild, warm antiseptic solution. Pulp nodules occasionally obstruct the ready diffusibility of the chemical. Removal of these calcareous deposits by means of sulphuric acid or by a drill, after cocain pressure anesthesia has been applied, is indicated. Cocain should never be applied cataphorically under these conditions, as the electric current will drive the previously applied arsenic through the apical foramen into the soft tissues. Occasionally one meets a patient who presents an unexplained idiosyncrasy to the action of this chemical.

The cavity for the reception of the arsenical application should be of ready access, and so prepared as to easily retain the temporary filling. The arsenical compound is preferably placed in direct contact with the freely exposed pulp by means of a blunt instrument, or on a depressed metallic disk or a piece of cardboard, or on cotton or spunk. Close contact insures quick action. Arsenic will act by osmosis, although slower, through any thickness of dentin. This very fact is the reason its use as a remedy for hypersensitive dentin has been abandoned; death of the pulp was invariably the sequence of such a procedure. Some operators prefer to cover the arsenical dressing with an intermediate film of plain or oiled paper, or pledget of cotton. The final sealing of the cavity consists of a temporary filling of cement or of a gutta-percha preparation.

Extreme care should be exercised in this simple, yet most important operation. Cotton fibers mixed with sandarac or mastic varnish, to be used as a retaining medium should be avoided; they readily become foul in the fluids of the mouth, or they may leak, and, besides, they swell, causing pain from pressure on the pulp. Kirk has advocated the use of surgeon's rubber plaster where but a portion of the tooth is left, carrying it around the tooth; it will adhere satisfactorily for several days, or long enough to accomplish the object. The gutta-percha preparations are the best media for a temporary dressing seal; most experienced operators agree that a cavity correctly sealed with this material offers less possibilities for the seeping through than the various cements or other materials. In Europe Fletcher's artificial dentin is used universally for such work. In applying the temporary stopping, it is very essential to avoid pressure on the dressing. In approximal cavities, where overhanging tooth substance prevents ready access, and therefore presents danger of misplacing the arsenical dressing, gutta-percha packed between the two teeth, and thus acting as a splint, is of service." (Prinz.)

The writer believes that it is best to avoid the use of arsenic if this can be done, as there is always a possibility of disturbances following its use, such as arsenical pericementitis or even necrosis. The former of these may not manifest itself immediately, but sooner or later it may appear either in a mild or an aggravated form.

If the arsenic is not sealed in perfectly, especially if the cavity extends below the gingival margin, necrosis is sure to ensue, which in some cases might have far-reaching effects. Some patients are peculiarly susceptible to this poison; and in the mouths of such, arsenic applied for a few hours only would be sufficient to devitalize the pulp completely, while in others it might remain for days with seemingly little effect. In the former case, if it were left in the tooth for any great length of time, it is almost certain that its action would not be limited to the pulp itself, but would extend through the foramen and beyond the apex and involve the surrounding tissue. Especially would this be true if the foramen were somewhat enlarged. The danger would be greater when using it on a young patient than on an elderly patient, as in the former the root may not be fully developed, and the foramen be widely patulous, in which cases, carbolic acid, creosote or some such agent is indicated.

Cases also occur in which there is an imperfection in the walls of the root-canals. A condition of this kind is fortunately very rare and it is one which it is impossible to foresee and guard against, If arsenic is used, disturbances which may result in serious injury to the patient are unavoidable. Very rarely it may happen that the pulp will resist the arsenic and repeated applications will have no effect, in which event, some other method of devitalization must be employed, although it will generally be found that where the pulp resists the action of the arsenic it is also likely to resist the action of any other drugs which may be used.

By far the safest and most rapid method is immediate devitalization. There are several different ways of accomplishing this by surgical means, either by the use of a general or a local anesthetic and extirpating the pulp at once with broaches or by using what was termed the heroic method. This latter consists of driving the pulp out with a pointed orange-wood stick without anesthetizing. Since the advent of pressure anesthesia, this method has become nearly obsolete, but there are still occasions where it can be used to advantage and a few words descriptive of the technique will not be out of place.

The Heroic Method.—This method was successfully employed, wherever possible, for many years by numbers of dentists who feared the use of arsenic. It was characterized, by some as being barbarous, and in fact, to one not familiar with the operation it might seem to be so, but there are times where it is indicated and if the operation is skilfully performed, it is instantaneous in accomplishing the result and comes as near being painless as any method that can be employed.

It is especially indicated in the anterior part of the mouth and for single-rooted teeth where there is a full exposure of the pulp, as in the case of a tooth broken off from a blow, leaving the pulp protruding.

In employing this method of pulp extirpation, the pulp must be well exposed and the operator should have a clear idea as to the general shape and size of the pulp canal of the tooth to be operate upon. The end of an orange-wood stick is whittled to correspond in size to the canal, and is placed within convenient reach together with a heavy, loaded mallet (Figs. 11 and 12).

If the crown of the tooth is to be removed, it may be cut as nearly through as possible by making a groove labially and lingually with a thin carborundum disk and then it is nipped off with excising forceps (Fig. 13).

The rubber dam should be applied wherever it is possible to do so. This having been done, the point of the orange-wood stick is dipped in carbolic acid and placed at the entrance of the canal and a quick, sharp blow given it with the mallet. If the orange-wood has been properly shaped, the pulp will be forced out between the canal wall and the stick, or will be found clinging to the latter when it is withdrawn. If this does not occur and any of the pulp remains in the canal, it is carefully removed with barbed broaches. The canal is then thoroughly cleansed, sterilized and filled.

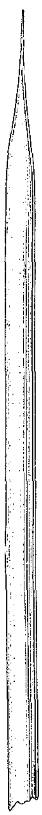


FIG. 11

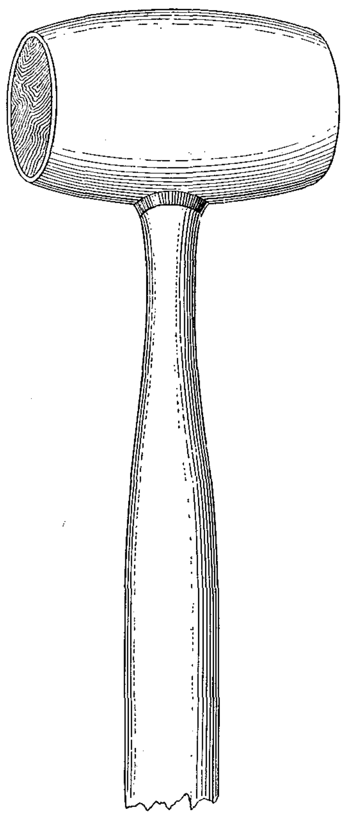


FIG. 12

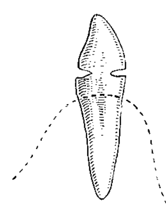


FIG. 13

This method is especially applicable to the single-rooted teeth, but it has been successfully employed in the upper first bicuspids and under favorable conditions, even to the larger canals in molars where the crowns have been so badly broken down as to render the canals easily accessible. In the upper molars, if the body of the pulp has been removed, that portion in the palatal canal may almost always be removed in this way, but the buccal canals are generally too small and difficult of access. In the lower molars the pulp in the canal of the distal root can be extracted, but in the mesial canals there would be the same trouble as in the buccal canals of the upper molars.

The operation is performed so quickly that the pulp is paralyzed by the shock, and the pain should be no greater than that felt from the slight prick of a pin. This happy result depends entirely upon the careful following out of the technique, for at the hands of an awkward manipulator it might cause the patient a great deal of pain

TREATMENT OF INFLAMED AND ACHING PULPS PREPARATORY TO DEVITALIZING.

It should always be borne in mind that neither arsenic nor an anesthetic will act upon an inflamed or congested pulp. If the pulp is in this condition, it has been the experience of the writer that a dressing of oil of cloves or eugenol and sulphate of morphia is one of the best applications for relieving the pain and reducing the inflammation. A pellet of cotton is saturated with the oil of cloves or eugenol and from one fortieth to one thirtieth of a grain of the morphia is added to it. This is placed in the cavity and allowed to remain until the pulp is quiescent, which will usually be in from twenty-four to forty-eight hours, after which the arsenic or the anesthetic may be applied.

Pressure Anesthesia as Used in the Removal of the Pulp.—With the introduction of pressure anesthesia the work of devitalizing and removing pulps has been very much simplified.

A number of instruments have been devised for anesthetizing the pulp through the crown of the tooth. These are in the form of a powerful syringe, by means of which great pressure can be obtained.

An opening is made through the enamel to the dentin with a small bur, corresponding in size to the point of the syringe, which is then placed in this opening, and pressure applied to force the anesthetic into the tooth structure. If the point fits the hole accurately, in a majority of cases a satisfactory anesthesia will be obtained. Many times, however, the syringe point does not accurately fit the hole through the enamel, the anesthetic escapes around it instead of being forced into the dentin, and in consequence the application is ineffective.

Another, and in fact the original method, is to place the anesthetizing solution into a carious cavity, or an opening made for the purpose, and over this a piece of unvulcanized rubber is placed. This is pressed into the cavity with a strong instrument, forcing a sufficient quantity of the solution into the tooth structure to produce a satisfactory anesthesia. This latter method is the one preferred by the writer. If the proper technic is carefully followed positive and satisfactory results may be confidently expected.

One, and perhaps the principle cause of failure in applying the pressure in this manner, is that the operator uses for carrying the solution a piece of cotton entirely too large for the purpose. The cotton is dipped into the anesthetic solution, placed in the cavity and the pressure applied. If the mass of cotton is too large to be covered by the rubber, some fibers are left projecting from the sides of the cavity; when the pressure is applied, these give vent to the solution, so that instead of its being forced into the tooth structure, it escapes by following the cotton fibers extending over the edge of the cavity.

It must be remembered that in applying pressure anesthesia in any manner whatsoever, that the pressure must be direct and positive, without any leakage, in order to force the solution into the dentin or into the pulp.

Sterile Field for Operation.—Before applying pressure anesthesia the greatest care must be used to insure a sterile field for the operation. If there is a gangrenous or septic condition of the body or any part of the pulp, this must first be corrected and the parts made as thoroughly aseptic as possible. If this is not done, septic gases or matter may be forced through the apical foramen and cause serious trouble.

In order to devitalize a perfectly sound tooth, an opening should be made directly on line with the axis of the tooth so as to gain direct and free access to the pulp. The first step is to grind through the enamel. This is best done with a small stump carborundum point, or a diamond disk or drill. The engine should be run rapidly and the tooth kept flooded with iced water, which prevents heating, and also acts as a slight obtundent. By using ice-water freely, the enamel can be quickly pierced, sometimes, even continued until the pulp is exposed, with but little or no pain at all to the patient. In the anterior teeth this opening is made on the palatal or lingual side, while in the bicuspids and molars it is made directly through the center of the tooth. Fig. 14.

The rubber dam is applied as soon as the enamel has been penetrated. If from any cause this cannot be done, napkins may be substituted to keep the secretions of the mouth from encroaching upon the field of operation.

The instruments needed should be ready at hand, convenient for instant use. These should include broaches for removing the

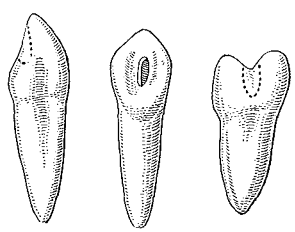


FIG. 14

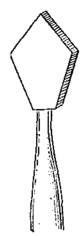


FIG. 15

FIG. 16

FIG. 17

pulp from the canals, a large spear-pointed drill, large coarse rose burs, a large cross-cut fissure bur, and one or two sharp spoon excavators which may be used to remove the body of the pulp.

A large spear-pointed drill is the best instrument for drilling through the dentin (Fig. 15). It should not be used for drilling through the enamel, as the latter is so hard that it quickly dulls the point, with the result that it not only takes more time, but the increased pressure necessary to make it cut, heats the tooth, and renders the operation much more painful than it would be otherwise.

It is very rarely these instruments are well made as they come from the dental depots. They are generally too thick and at the cutting edges are not backed off sufficiently to cut well. They can be greatly improved by first grinding them very thin and then backing them off so as to leave a good sharp-cutting edge which will cut deeply and cleanly into the dentine and clear itself readily. (Fig. 16). If the edges are thick and straight across and have not this clearance (Fig. 17), the drill will drag and heat, causing pain and rendering the operation more lengthy and difficult.

The enamel having been pierced, the rubber dam is applied, the tooth thoroughly dried, and the point of the drill placed on the dentin pointing in direct line with the axis of the tooth's root, with the engine running at high speed. As soon as the patient experiences pain, it is time to begin the use of pressure anesthesia.

Ethyl chloride may also be used in making the exposure. In drilling the opening, when the tooth begins to be sensitive, the spray should be applied, intermittently at first, touching the tooth only for an instant, repeating at short intervals, each time keeping it on for a little longer period, until the tooth becomes insensible. In this way the tooth is cooled gradually and the pain or shock which occurs when the spray is applied directly and continuously is avoided. The spear-pointed drill is now used, and if the tooth again becomes sensitive before the pulp is reached, the spraying is repeated.

There are a number of different preparations used in the devitalization or the anesthetizing of the pulp. Novocain seems to be a favorite agent with many dentists. The writer, however, has had excellent results from using the pure crystals of cocain in conjunction with some fluid as a vehicle, usually favoring a local anesthetic solution.

The local anesthetic, which seems to work best, and in fact, has been found by the writer superior either for extracting or wherever a local anesthetic is indicated, is as follows:

Acid, carbolic		10 gr.
Cocain hydrochlorid		10 gr.
Atropia sulphate	2 per cent. solution	10 min.
Nitroglycerin	1 per cent. solution	10 min.
Adrenalin chlorid	Sol. (1 : 1000)	10 min.
Distilled water		2 oz.

After using and recommending it for nearly twenty years, the writer has neither seen nor heard of any ill results following its use. It is, however, wise to use this, and all allied preparations with caution, using no more than is absolutely needed.

In making the application, only a very minute piece of cotton should be used. A piece no larger than one-quarter the size of a pin head is ample for the largest tooth. This is dipped in the anesthetic solution and then a slight excess of the cocain, which has previously been finely powdered on a glass slab, is taken up on the cotton and it is placed at the bottom of the cavity.

A piece of soft, unvulcanized rubber is then placed over it and pressure brought to bear with an instrument which nearly fills the opening. It must be remembered that in order to obtain perfect results there must be a positive pressure, and if the instrument be too large or too small it will not do the work as well. If a positive pressure is obtained, it is not necessary to keep it up longer than from twenty to thirty seconds. The vulcanite and the pellet of cotton are then removed, the opening dried, and the spear-pointed drill is once more used.

If the tooth becomes sensitive again before the pulp is exposed, the operation is repeated. It will be found, however, that, as a general rule, with one or two applications of the anesthetic, the exposure can be obtained, without pain to the patient. After the exposure has been made, the final application should be made directly on the pulp, the pressure being kept up for about thirty seconds, when it will be found that the pulp has been completely anesthetized and the pulp chamber can be opened and the pulp removed.

It should be remembered that in using the anesthetic with pressure, the pulp is not devitalized, but simply anesthetized, and if the operation of removing the pulp is long continued, sensation may return. In multi-rooted teeth, when the canals are very minute and difficulty is experienced in opening into them, sensation may return to the pulp of one or two of the canals while the pulp was being removed from the others. This necessitates a second application.

If the tooth has been broken down by decay and a cavity exists through which the pulp is accessible, this cavity may be utilized. The disintegrated tissue, however, must first be thoroughly removed, for its presence will hinder the action of the drug. The anesthetizing solution on a small pellet of cotton is then placed in the cavity, and pressure applied as before described.

If the pulp cavity is freely exposed, the anesthetic may be injected into it with a hypodermic syringe. This, however, is more painful, and possesses no advantage over the method just described.

CHAPTER IV.

THE PULP CANALS.

POSITION OF THE PULP CANALS.

Before undertaking to remove the pulp from devitalized teeth, the operator should have an accurate knowledge of the anatomy of the teeth. He should know the number of roots which each tooth should possess, and where to look for entrance to the canals on the floor of the pulp chamber of a normal tooth, and should also be able to form some idea of their approximate size.

Some of the canals are frequently very minute and difficult to locate, and a knowledge of their normal position is helpful in finding them.

All operations are more quickly and thoroughly done if the operator works systematically, and by some well-considered rule. This applies with much force to the operation of locating and opening the pulp canals.

Opening into the Pulp Chamber of Molar Teeth.—In enlarging the entrance to the pulp chamber do not fear to make a large opening. It is impossible to get into the different canals in the molars, and cleanse them as they should be cleansed, through a minute opening in the crown of the tooth. A large opening should be made through the crown, and the pulp chamber opened to its full size so that the entrance to every canal is easily accessible. It does not weaken the tooth to do this. As a chain is only as strong as at its weakest point, so with a tooth, and this point is where the pulp chamber approaches the sides of the tooth (Fig. 18).

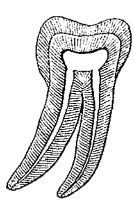


Fig. 18

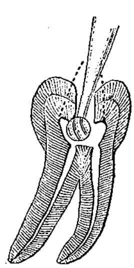


Fig. 19

After drilling into the pulp chamber, the enamel at the entrance to the cavity should be removed with a cross-cut fissure bur, but the use of this bur should not extend to the pulp chamber. The best instrument to enlarge this, is a large rose bur, passing it through the opening and under the ledge, or as it might be termed, the roof of the pulp chamber, and pulling the bur toward the occlusal surface (Fig. 19).

This should be continued until the explorer shows that the sides of the cavity are flush with the sides of the pulp chamber and the explorer slides smoothly into it.

A fissure bur, an inverted cone, or any square-ended instrument should not be used in doing this work, as they are sure to strike the sides of the pulp chamber, leaving ledges or grooves on which the broaches will catch, and render the locating of the canals much more difficult; whereas, by using round burs only, the floor of the pulp chamber, is not marred, there will be no roughness to interfere with the instrument, which will then much more readily find the openings to the different canals.

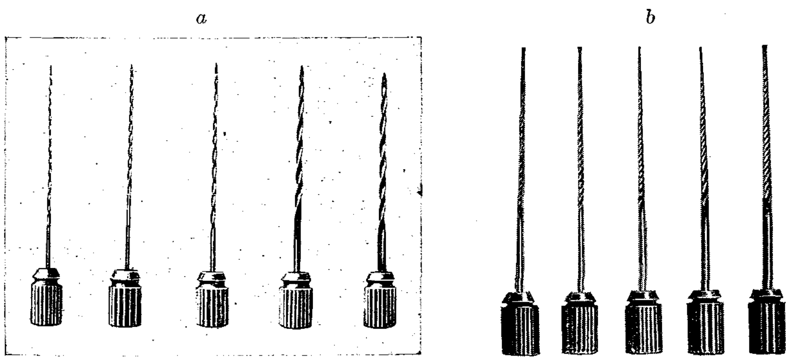


FIG. 20.—*a*, Kerr broaches; *b*, Kerr canal files.

Locating the Pulp Canals of the Upper Molars.—As a rule, it is more convenient to first locate the palatal canal in the upper molars. This canal is much larger, and occupies a position which renders it more easy of access than are the others, and it is rarely that there is any trouble in locating it at once and removing the pulp.

The writer has found that the best instruments for locating the canals are the short, knob-handled broaches of the Kerr or Downey type (Fig. 20). These instruments are made of triangular steel wire, twisted, and brought to a fine point. They are much stronger and are less liable to be broken than are the barbed broaches. Then, too, being shorter, without barbs, and with just the right degree of stiffness, they admit of a far more delicate sense of touch than does a long and very flexible instrument.

When using these broaches, if conditions permit, the rubber dam should always be in place, but if this is not possible, the mouth should be protected with napkins, so as to keep the parts dry, and also, if the broach should slip from the fingers, to prevent its dropping into the throat.

The palatal canal having been located, the next one to look for is the anterior buccal. To reach this, the handle of the broach is passed distally and palatally, reaching the point of the instrument far forward toward the mesiobuccal corner of the tooth, and if the pulp chamber has been carefully opened, there will be very little difficulty in finding this canal. It sometimes happens that the entrance to this canal is located so far mesially that it will be necessary to cut entirely through the mesiobuccal corner of the tooth in order to get free access to it.

There still remains the distal canal to be accounted for. If, when the instrument is in the anterior buccal canal, it is slowly withdrawn, sliding the point lingually through the groove in the floor of the pulp chamber, as a rule the point will find the entrance to this canal with but very little difficulty. These canals are often very minute and extremely difficult to open. For this the Kerr, or Downey, broaches are used, beginning with the small ones, and working very carefully; using little or no force to push them into the canals, but allowing them to work their way easily as the broach is rotated. The sodium and potassium preparation may be used to advantage in such cases, working it in with a broach. Sodium dioxide is also used for this purpose, and will at times prove quite effective. Again, a 50 per cent. solution of sulphuric acid may be of assistance. A little of it, indeed, may be sealed into the root and allowed to remain until a subsequent sitting, when it frequently will have so softened the contents of the canal that the broach will readily find its way to the end.

Fig. 21 will give a fair idea as to the position in which these canals are generally found, the large palatal canal *c* being about in the center of the palatal root and the anterior buccal canal *a* being found very close to the anterior buccal corner. The distal canal *b* will be found nearly on a line between the anterior buccal and the palatal canal, or slightly distally to it, but very rarely at right angles with the other canals. Occasionally, the two buccal canals have a common opening into the pulp chamber (Fig. 22), and in such cases, the entrance to the separate canals will be found just a little below the pulp chamber floor.

Occasionally, but very rarely, an upper first or second molar will have but a single root. When this is the case, the canal will be very large, the pulp chamber sloping from all sides toward the center of the tooth, and the canal tapering to the apex (Fig. 23).

Again we may find one of these teeth which has two roots. When this is the case the buccal canal is usually as large or even larger than the palatal canal. If, on opening the tooth, the instrument drops readily into the buccal canal, midway between the mesial and distal sides of the tooth, and if it is very much enlarged throughout its entire length, it is a fairly certain indication that there are no more than two canals. If, on the contrary, this canal is very much constricted, it indicates the existence of another canal.

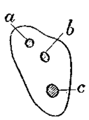


FIG. 21

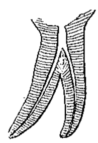


FIG. 22

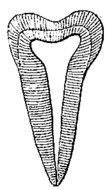


FIG. 23

FIG. 24

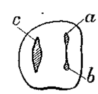


FIG. 25

Where the molar has four roots, the two palatal canals will generally be larger than the two buccal, and one will be almost directly behind the other following the line of the arch (Fig. 24, *a* and *b*), although neither of them will be as large as where there is but a single palatal root. The two buccal canals will be about in normal position (Fig. 24, *c* and *d*).

Locating the Pulp Canals of the First and Second Lower Molars.—Normally, the lower molars have but two roots, almost invariably, however, there are three distinct canals which must be cared for, one in the distal, and two in the mesial roots. While in reality there is but a single canal in this root, it is so constricted between the buccal and lingual openings that this part of the canal is almost obliterated, the space between the walls of the canal at this point being so slight that there is, practically, no pulp tissue between them (Fig. 25).

The distal canal *c* being the one most easily accessible, is naturally the one first looked for. This canal being much larger than those in the anterior root, and the position being favorable, it is readily located and the pulp easily removed.

The canal next sought for is generally determined by the inclination of the tooth, if this be excessively to the lingual it would naturally be the lingual canal (Fig. 25, *b*), as this position of the tooth renders it more easy to reach. In locating the canals in this root, the rule in regard to the order in which they are opened is not followed as closely as it is in locating the buccal canals in the upper molar. At times, the buccal canal (Fig. 25, *a*) is more quickly and easily located than the lingual.

Very frequently the distal slope of these roots is such that it will be necessary to cut the mesial wall of the tooth almost to the gum line in order that the instrument may follow the line of either the mesial or distal canals (Fig. 26). The buccal canal of the mesial root is the principal offender in this respect, and it is sometimes necessary to cut the mesio-buccal corner of the tooth entirely away before an entrance into the canal can be effected.

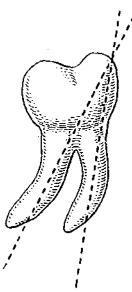


FIG. 26

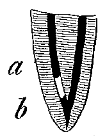


FIG. 27

The mesial canals are frequently so constricted and tortuous as to render it extremely difficult to open them all the way to the apex. At times it is necessary to spend hours, or even days, toget these canals properly opened and enlarged, but one of them, at least, *must* be opened all the way to the end of the root.

These canals sometimes diverge buccally and lingually as they leave the pulp chamber, and converge as they approach the apex, having a common foramen (Fig. 27).

If it is practically impossible to entirely open but one of these canals, and the other has been opened to within a very short distance of the apex, the little pulp tissue remaining in this small space between the filling that is to be placed in the canal which has been opened to the end of the root, and the filling which will be placed as far down in the other canal as it can be placed (Fig. 27, *a* and *b*), will hardly do any harm.

The canals, of course, must be perfectly sterilized, particular attention being paid to the one which has not been opened entirely to the apex. The canal from which the pulp has all been removed is filled very carefully, making certain that it is filled all the way to the end. The remaining canal, which has not been fully opened, is saturated with a solution of zinc chloride, after which it is filled as far as possible, so that only a little thread of coagulated pulp tissue is left in the root. This is entirely cut off and isolated so that the danger of subsequent trouble is very remote. If the operator desires, this canal can be filled with some mummifying paste, but it is only in cases of this kind that such a filling is indicated.

Occasionally these teeth, as in the case of the upper first and second molars, may possess a greater or less number of roots than normal, and there may be but a single root or there may be several. There is rarely any trouble in opening the pulp canal of a single rooted lower first or second molar, all the way to the end of the root. As in the case of an upper molar, the pulp is always very large and peg-shaped, so that it is easily removed.

The third molars or wisdom teeth are especially lacking in uniformity as to the number of their roots; they may have but a single root or there may be many. These roots frequently converge and may be fused together forming one large peg-shaped root in which there may be several canals. These canals are frequently so small and tortuous as to render it impossible to open all of them their entire length. In such cases, the operator must be satisfied with something less than the ideal, so far as filling them to the end is concerned, but should make every effort to insure that they are at least perfectly sterile.

It is this uncertainty in regard to their condition which sometimes renders them unserviceable as abutments for bridge-work. In such teeth it would be impossible to give any fixed rule as to opening of the canals and removing the pulp, except that the pulp chamber should be fully opened so as to give free access to all the canals which it is possible to find.

Locating and Opening up the Pulp Canals of the Upper Bicuspids.— The upper first bicuspid, is a double-rooted tooth with the canals opening on the buccal and lingual side. The canals of these roots are sometimes quite constricted, and require considerable time to open them all the way to the end. With a little perseverance and the use of the sodium and potassium, or sulphuric acid, this can, however, generally be accomplished.

Occasionally the root has a very sharp curve near the apex. Indeed, it is at times bent almost, if not quite, to a right angle with the rest of the root. In such cases it will be impossible to remove all of the pulp tissue. As much as possible is taken away with the broaches, using the sodium and potassium, or the sodium dioxide, and then trust must be placed in antiseptic treatment to prevent future trouble. There are times when it may be advisable to amputate these curved root ends, before using the teeth as abutments.

The upper second bicuspids sometimes show exactly the same conditions as are to be found in the mesial root of the lower molars, a single root, but practically two canals, which should be treated in a similar manner to those of the lower molars. These canals may be entirely separate and present all the appearance of a first bicuspid, but if they are opened all the way to the end, it will be found that they unite at the apex in one common foramen, and if one of the canals be filled, the filling will be forced a little distance up into the other canal.

A two-rooted second bicuspid occasionally is found, but this is rare and need not be especially considered, as the treatment would be the same as for the first bicuspid.

FIG. 28

FIG. 29

Locating and Opening up the Pulp Canals of the Lower Bicuspids and Anterior Teeth.—The lower bicuspids have but a single root, and the pulp is approached directly through the center of the cusp.

All of the six anterior teeth, both upper and lower, are opened from the lingual side, as near the center as possible, and it is very rarely that any trouble will be encountered in removing the pulp and thoroughly sterilizing the canals.

X-rays in Pulp Canal Work.—The discovery of the Roentgen rays and the introduction of the *x*-ray machines has been of great value to the dentist, and especially so in pulp-canal work. It has enabled him to open up the pulp canals, and to work with almost absolute certainty, where, before its introduction, he had been working in the dark, and pulp canal operations were, to a certain extent, mere guesswork.

In all cases where there is the least uncertainty, and in fact, in treating any of the teeth, and especially those having more than a single root, it is advisable to have an *x*-ray taken before beginning operations. The film will show at a glance the number, position, and approximate length and shape of the roots, and the location of the canals, thus enabling the operator to work much more quickly than he otherwise could (Fig. 28).

In difficult cases, after having opened and enlarged the canals, it is an excellent plan to insert fine wires to the depth to which they have been opened, and then have another x-ray taken to verify

FIG. 30.—Wires in canals showing distal canal perfectly opened to apex, but wire in mesial root shows side of root slightly penetrated anterior to the canal.

FIG. 31.—Upper first bicuspid showing buccal canal entirely filled and palatal canal only upper third filled, the balance of canal being used to insert a post for a crown.

the work (Fig. 29). The illustration shows this very clearly, and we can appreciate the value of these pictures as an aid in this work. Many times, as in Fig. 30, the second picture will show that a canal, in which it was thought that the work had been perfectly done, had not been opened nearly to the end, and had it been filled without carrying the work further, might have resulted in serious trouble. At times it is well to submit the patient to a third exposure before proceeding to fill the canals. It is also often advisable in difficult cases, and at all times a great satisfaction, to know whether our work has been perfectly done, or otherwise. An x-ray taken after the roots have been filled will readily show this (Fig. 31).

FIG. 32.—The above radiograph shows a sharp turn backward of the mesial root of the lower first molar and the canal only partly filled. With the aid of the film, it was possible to open up both roots easily and quickly all the way to the apex.

The use of the x-ray is often a great saver of time. At times the writer has worked for hours over a tooth, endeavoring to open up certain canals, but has failed until an x-ray of the root has been taken. This has shown, perhaps, a curve in the root which necessitated the cutting away of a large portion of the mesial wall of the crown before it was possible to get into the canal more than a short distance, but after securing the films, he has been enabled to complete the work and open the root all the way to the apex within a very short time (Fig. 32).

The value of the x-ray to the dentist cannot be overestimated, and those who are taking advantage of it are doing far better work than it would be possible for them otherwise to do. A chapter on this work has been written by Dr. Frederick K. Ream, of New York, and will prove very instructive reading.

REMOVING THE PULP AND CLEANSING THE PULP CANAL.

The Donaldson canal cleansers, and instruments of that type are best suited for the purpose of removing the pulp where the canal is sufficiently large to admit of their entrance (Fig. 33). These broaches are barbed on all sides, the barbs being cut around the shaft following the direction of the thread of a right-hand screw. Such instruments should be used with care, being necessarily very delicate, as in barbing them, the broach is cut partially through, weakening it to a great extent.

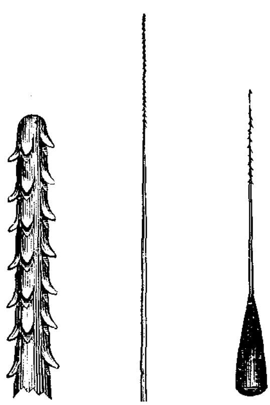


Fig. 33.—Donaldson's pulp canal cleansers.

The broach should be held in the fingers lightly and sholud never be forced. In entering the canal the broach is rotated slightly to the right, allowing it to be drawn into the pulp tissueand after entering to a sufficient depth may be withdrawn with the pulp, or a portion of it adhering to it. Never allow the broach to become jammed. Keep touching lightly, twisting it the least bit with each forward motion until it catches a little, then withdrawing it, and continue these movements until the apex is reached. Should the broach become jammed, it is released by rotating carefully to the left.

Where the canals are very small, the Kerr or Downey broaches can be used to enlarge the canals and remove the pulp, beginning with the smaller broaches and working up to the larger. While these broaches are much stronger than are the Donaldson, care must be exercised in their use, as the finest of them are very delicate.

Where the canals are so minute that trouble is experienced in opening them, even with the finest broaches, the use of sodium and potassium, or sodium dioxide, is indicated, the soldium and potassium being preferred. A small amount of the preparation is carried to the canal on the broach and worked into it with a pumping and rotating motion. This will facilitate matters and tend to enlarge the canal slightly, so that the broach may readily follow it.

At times a drop of 50 per cent. sulphuric acid in the canal will very materially assist in the work, and sometimes if a little of the acid is sealed in the canal and left there until a subsequent visit of the patient, it will frequently enable the remainder of the canal to be easily opened.

The openings from the canals into the pulp chamber are generally somewhat constricted, as shown in Figs. 18 and 19. They should be slightly enlarged at this point with a Gates-Glidden drill. They are thus not only rendered easier of access to the broach, but the removal of the pulp is also facilitated.

Instruments must be Perfectly Sterile.—It is to be understood that in all of these operations, the instruments must be thoroughly sterilized before using, and sometimes during the operation. This is best done in superheated steam or by boiling. The former is by far the most thorough and efficient of any method which can be employed. Fig. 34 shows an apparatus for sterilizing by steam. The instruments are placed in a tray, which is put in a highly heated cylinder. A little water is then injected into the cylinder and is instantly converted into steam of several hundred degrees of heat and the instruments are thoroughly sterilized in a very few moments.

Formalin is also a very good sterilizing agent, but it is better to use a stronger solution than is generally employed for this purpose. A solution of Formalin diluted with water alone will corrode the instruments so as to ruin them in a short time, but a solution composed of one part formalin to three parts of a saturated solution of bicarbonate of soda, may be safely used and is very effective.

Instruments placed in this solution and left for several days will remain as bright and clean as when first put in.

The canal should first be cleansed mechanically, the sides being thoroughly scraped with the barbed cleansers so as to remove every particle of pulp tissue that it is possible to reach.

At all times, after the pulp has been removed and the canals opened, it is well to use the sodium and potassium. A platinum point is best suited for this purpose, although twisted broaches of the Keer or Downey type may be used. A small portion of the sodium and potassium is taken up on the instrument, carried into the canal and worked in as previously described. This will have a tendency to destroy any organic matter remaining in the canal and render it perfectly sterile.

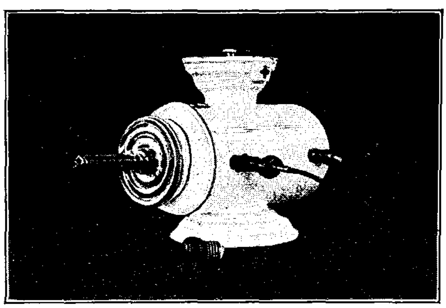


Fig. 34

The sodium and potassium may be used freely, but its use must not be carried to an excess, as an excessive use of this agent has a tendency to burn the life out of the tooth structure and render it brittle.

After the canals have been opened to the end of the roots, those which are very minute should be enlarged sufficiently to allow the filling to be properly inserted. This can be done with the canal files by working them back and forth in the canals until they are of the desired size. The Donaldson canal cleansers can be used, but greater care must be exercised, as they are more easily broken.

When the canals are not to be filled at the time of the removal of the pulps, a small portion of the sodium and potassium may be sealed in the canals until a subsequent sitting.

This delaying the completion of the work, to a subsequent sitting, applies especially to the multi-rooted teeth, where the canals are very minute, and much difficulty has been experienced in opening them.

In the single-rooted teeth, and also in the larger canals of the molars, where there has been no difficulty in opening them all the way to the end of the root, the work of devitalizing and removing the pulp, the cleansing and sterilizing of the canals, and the filling of the root should be completed at one sitting.

Where the work has been delayed, when the patient returns and the tooth is opened, the use of the sodium and potassium is repeated, but only a moderate quantity should be used. The canal is then thoroughly washed with a solution of bichloride of mercury and peroxide of hydrogen, the solution being composed of one and three-quarter grains of bichloride of mercury to two ounces of peroxide of hydrogen. This makes a bichloride solution of a strength of about one to five hundred and will insure the thorough sterilization of the canals. This solution should not be used, however, until just previous to filling the roots. If it is sealed into the canals, it is apt to cause the patient pain, which may continue for some time. After having used the bichloride solution, the canals are wiped out and thoroughly dried with alcohol preparatory to filling.

Where the pulp has been removed and the canals are to be filled at the same sitting, the operator should proceed in the same manner, using the sodium and potassium thoroughly, and then washing the canals with the bichloride solution and drying them.

TENDERNESS OR SENSITIVENESS AFTER THE REMOVAL OF THE PULP.

Tenderness or sensitiveness after the removal of the pulp may be due to a minute portion of pulp tissue missed by the broaches, and still adhering to the walls of the canal. This is especially likely to occur when the canal is very much flattened, and the pulp is compressed to a knife-like edge, generally on the lingual or palatal side (Fig. 35). This is most likely to occur in the cuspids and lower bicuspid teeth.

FIG. 35

Occasionally, when a patient returns to have the pulp canal filled, on a visit subsequent to that on which the pulp was removed, the tooth will be extremely sensitive. When such is the case, it is quite likely that a small portion of pulp tissue still remains in the canal.

Sometimes the pain will cease at once on thrusting a barbed broach quickly to the end of the root and twisting it. Generally, however, the sodium and potassium preparation will enable us to remove this thread of sensitive tissue.

In obstinate cases it may be necessary to use a little cocain, or local anesthetic, pumped as far into the canal as possible, before being able to remove the cause of trouble.

ENLARGING THE PULP CANAL.

In enlarging the canals for the reception of the post, none but safe-ended instruments should be used. Instruments such as rose burs, spear-pointed drills, fissure burs and those of a similar character, should never be employed for this purpose, as they will not follow the canal, and there is danger of perforating the sides of the root, and causing trouble for both the patient and the operator.

Determining the Length of the Root.—When enlarging the pulp canals it is important to first determine the exact length of the root, so as to know just how far it will be safe to go and how long a post can be used. The Kerr broaches or canal files, or instruments of a similar type are suitable for this purpose, beginning with a very fine one, and carrying it slowly to the apex, first cautioning the

Fig. 36.—Gates-Glidden nerve-canal drills.

patient to give notice on the first sensation of pain, or of feeling the instrument at the apex. After testing carefully a number of times to be certain that no mistake has been made by the patient, the depth to which the instrument has gone can be registered by pushing a small piece of rubber dam over the broach and pressing it down on the face of the root, or the incisal edge of the tooth, while the point is at the apex. This gives an exact measure of its length. The larger broaches can then be used, but only to within about one-eighth of an inch, or a little less, from the apex. Gates-Glidden drills, Fig. 36, of different sizes, beginning with the smallest and ending with the largest, can then be used to the same depth.

These latter instruments are safe-ended, having a round, smooth guide point, which will follow an opening, but will not cut at the end (Fig. 36, *a*). The instruments should not be forced at all, but should be allowed to work their own way into the canal, withdrawing frequently to clear them, and just touching lightly until the desired depth has been reached.

These instruments were first made with the shank tapered, with the lightest and weakest part close to the head (Fig. 36, *b*) and if broken, only the head of the instrument remained in the canal. It was very difficult, at times, indeed, impossible, to remove them. Later they have been made tapered in the opposite direction, so that the lightest and weakest part is far up on the shank, and if broken at this point (Fig. 36, *c*) the part left in the root can be removed with comparative ease. When purchasing instruments it is wise to see that they are of the later pattern.

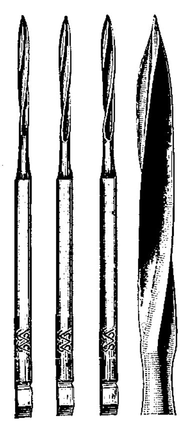


Fig. 37.—Root-reamers.

The Gates-Glidden drills are followed with reamers of suitable size, bearing the writer's name (Fig. 37), enlarging the canal sufficiently to take a pin or a tube of the size desired. These instruments are also safe-ended, having a smooth-rounded guide point the same as the Gates-Glidden drills. They will follow the canal and enlarge it, but will not cut at the end, and in using them there is not the slightest danger, hardly a possibility, with ordinary care, of perforating the root.

The manner in which the canal of a tooth is enlarged depends upon the style of a crown that is to be used.

Enlarging Pulp Canals for Richmond Crowns.—Where a Richmond crown, or a crown with porcelain facing and a solid metal back is to be used, after the canal has been opened, the reamer is partly withdrawn and sloped lingually, enlarging the canal at the gingival end of the root in that direction (Fig. 38, *a* and *b*). The object of enlarging the canal in this manner is to allow plenty of room labially, to place the facing.

If, in any of the six anterior teeth, the canal is simply enlarged on its original line, the facing will come directly over the opening. This would necessitate cutting the pin off flush with the floor of the cap, in order that the facing might set flat on the floor (Fig. 39). The aternative would be to pursue another method. This consists of grinding the lingual side of the facing, toward the gingival end, and curving it outward so that only a small portion of it rests on the extreme labial side of the cap. The backing is then made to conform with this, coming down flush with the floor, thus making room enough to engage the pin in the solder (Fig. 40).

In the first method, by grinding off the pin, and setting the facing flat on the floor of the cap, the crown would be rendered very weak, as the only attachment the post would have would be to the thin

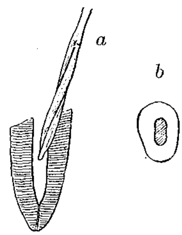


FIG. 38

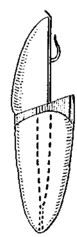


FIG. 39

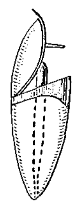


FIG. 40

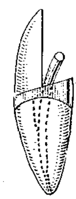


FIG. 41

floor of the cap, and but little force would be necessary to tear it away (Fig. 39). By sloping the canal lingually and then giving the post a slight bend in that direction, it will leave plenty of room labially to place the facing in its proper position without weakening in the least the attachment of facing or post (Fig. 41).

The objection to the second method, that of grinding the facing labially, carrying the backing down to the point of contact with the floor of the cap, and filling in this space with solder, is that it

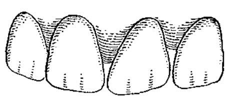


FIG. 42

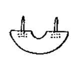


FIG. 43

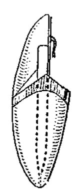


FIG. 44

too often makes the work conspicuous. The mass of gold being carried so near to the labial face of the tooth renders it visible. It will glitter, or cast an ugly dark shadow between the teeth, and be very unsightly. This is especially true if the teeth are quite fan-shaped, with broad spaces between them near the necks and applies particularly to the upper six anterior teeth (Fig. 42). There are times when the facings may be gound in this manner, as in the case of the bicuspids, or more rarely, even in the cuspid, where they are broad at the neck, but ordinarily it is not advisable.

Enlarging Pulp Canals for an all Porcelain or Downie Crown.—Where an all porcelain crown or a Downie crown is to be used, either building up the entire crown with porcelain, or using a facing and building up the lingual portion only, the canal is simply enlarged in its original direction so that the pin will set directly in the center of the tooth. This applies especially to the upper anterior teeth where there is but little force exerted except in an outward direction. The reason for this is as follows: Porcelain is a very fragile material and its strength is only in proportion to its bulk. By having the post in the center of the root, and cutting a groove on the lingual side of the facing between the tooth pins (Fig. 43), so that the post will set in nearly flush with the back of the facing, it permits a greater bulk of porcelain lingually to the post, thus giving increased strength to the crown (Fig. 44).

If the post is allowed to come lingually, as in the case of a Richmond crown, it would permit of but little porcelain back of it, particularly if the bite was very close, thus rendering it very much weaker than it would otherwise be. This does not apply so particularly to the lower anterior teeth as with them the greater pressure is inward.

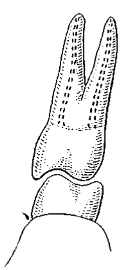


Fig. 45

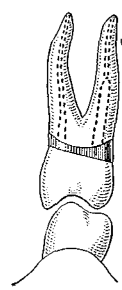


Fig. 46

When placing a Richmond or a porcelain crown on an upper first bicuspid root, it is very rarely that there is any necessity for using more than one of the canals for the post and the palatal canal should always be chosen. In mastication, the force exerted on these teeth is always upward and outward (Fig. 45), consequently if the post is well anchored into the palatal root, there will be no necessity for a post in the buccal root, for the reason that the direction of force is such that the crown will always be forced tightly against the root on the buccal side, and the post in the palatal canal will bind it firmly to the root at that point (Fig. 46). The only exception to this is where the teeth have extruded somewhat, and the roots are much decayed far down under the gum. From the fact of their being so short, it might at times be advisable to utilize both canals in order to give the necessary retention.

FILLING THE PULP CANAL.

There are many different methods and materials used for filling pulp canals. Satisfactory and permanent results, however, depend fully as much on the manner in which these fillings are inserted as it does on the materials which are employed for the purpose. Among these we find gutta-percha points, oxychloride of zinc, gold, chlora-percha, paraffin and even wood points. It is probable that gutta-percha and oxychloride of zinc are more extensively used than are any of the others.

Gutta-percha Points.—Of all materials, the writer believes that the very best results are obtained from using gutta percha points. He also believes that a filling of this material is much more easily inserted, and that it is possible to carry the filling to the extreme end of a very fine canal with a great deal more certainty than can be done with any other material.

As a preliminary to the operation, it is understood that the rubber dam is to be applied, if the conditions will permit, and if not, napkins should be used to keep the mouth as dry as possible.

A point is selected of a size corresponding to the canal which is to be filled, and placed for a time in the bichloride solution to sterilize it. It is then dried on a napkin and attached to the end of a canal-plugger by heating the point of the instrument. The canal, being thoroughly cleansed and dried with alcohol, is slightly moistened with eucalyptus oil, carrying it into the root on a small wisp of cotton twisted around a broach, or between the points of a pair of fine dressing pliers. The gutta-percha point is first dipped into the oil of eucalyptus and then just the tip of it into aristol, or iodoform, after which it is placed in the canal and worked into it with a slight pumping motion, carrying it farther and farther, as the oil softens it, until the extreme apex is reached, which, in the majority of cases, can be told by the patient wincing. If the point has not become loosened from the plugger by this time, it can be freed by rotating the plugger a little, after which the point is packed tightly into the end of the canal.

It is not objectionable to see the patient wince a little during the operation of filling a pulp canal. In fact, it is rather desirable, as it is a very good, though not an infallible indication that the end of the root has been reached.

Chloroform may be used in place of the eucalyptus oil, injecting it into the root and working the point with a pumping motion the same as where the oil is used. It is not probable, however, that it will make as perfect a filling as where the eucalyptus oil has been used. The chloroform evaporates or penetrates the tooth structure very rapidly, so that the softened gutta-percha soon becomes a sticky mass adhering to the side of the canal, and has a tendency to prevent the point going freely to the apex. Then, too, the rapid evaporation of the chloroform is liable to cause a shrinkage of the gutta-percha, so that after a time it ceases to fully fill the canal.

The eucalyptus oil is much to be preferred to chloroform, as it is of a healing and soothing nature, besides possessing antiseptic properties which persist in the canal for many years. It is also a slight solvent of gutta-percha, and makes an excellent lubricant, so that the point slides into the canal freely.

The canals are filled with the gutta-percha to within about one-sixteenth of an inch of the floor of the pulp chamber. The part which remains unfilled is then carefully cleansed with alcohol and dried thoroughly, after which it is filled with oxychloride of zinc.

Where it is intended to enlarge the canal in order to insert a post as an attachment for a crown, the canal may be enlarged at once, with a reamer, to the desired size and depth, enlarging it to within about one-eighth of an inch, or a little less, from the apex, before filling.

A very short gutta-percha point is then used, dipping it in eucalyptus and aristol, and just filling the apex, packing it tightly against the shoulder left by the reamer (Fig. 47). The canal is then wiped dry and the gutta-percha covered lightly with oxychloride of zinc.

FIG. 47

Filling Pulp Canals with Enlarged Foramen.—Where the apical foramen is very much enlarged, as it will be in the case of an undeveloped tooth, gutta-percha is the only suitable material for filling, and care must be used so that the filling is not forced beyond the apex. The exact length of the root is first ascertained by passing a hooked broach through the enlarged opening and marking the length with a small piece of rubber placed over the broach (Fig. 48, *b*).

It is always advisable to have at hand a series of different sized canal pluggers, from which one is selected which will pass into the canal only to within about one-eighth of an inch, or a little less, from the end (Fig. 48, *a*). This can be told by placing it alongside of the hooked broach used for measuring its depth. A blunt gutta percha point is now selected, slightly larger than the end of the canal plugger and a little shorter than the distance from the end of the plugger to the end of the canal (Fig. 48, *c*). This is attached to the end of the plugger, and is then dipped in eucalyptus and aristol and pressed firmly in place at the end of the root, the canal having been previously dried. The plugger is then loosened by rotating, after which the canal is washed and dried with alcohol and the gutta-percha is covered over lightly with oxychloride of zinc.

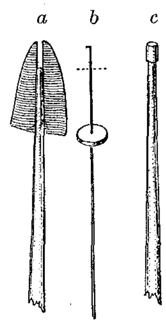


FIG. 48

The diameter of the gutta-percha point having been somewhat greater than that of the canal to be filled and also slightly shorter, it packs very tightly in place as far as the plugger point will carry it, and at the same time the contraction of the canal elongates it a little, so that the apex is perfectly closed. Then too, the plugger being of large size, renders it impossible for the filling to be forced beyond the point desired, and through the foramen where it might act as an irritant.

A plugger of a smaller diameter than the apical foramen should never be used in filling these canals. An accident or a sudden movement of the patient might cause the filling to be forced through the end of the root, with no possibility of removing it.

If the entire length of the canal is to be filled, the operation will be very similar to the one described. The size of the foramen is ascertained with a suitable plugger. The plugger used for filling should be just large enough so that it will pass into the opening of the canal from the floor of the pulp chambers, not much more than one-sixteenth of an inch. The size and length of the gutta-percha point is determined from these two pluggers and the hooked broach. It is made of a slightly larger diameter and a little shorter than the canal. After it has been dipped in the eucalyptus oil, it is packed tightly in place as far as the plugger point will carry it. The one-sixteenth of the canal remaining unfilled, is covered with oxychloride of zinc.

Where chlora-percha is used as a filling, a little iodoform or aristol should first be put into the canal, after which the chlora-percha is pumped in with a broach, a fresh supply being added as the chloroform evaporates.

When it is carried well into the canal, a gutta-percha point may be forced into it, but it is questionable if this will make as perfect a filling as a gutta-percha point, as there is necessarily a much greater shrinkage where chloroform is used than there can be with only a very small portion of the oil of eucalyptus.

Oxychloride of zinc should never be used for a filling where the foramen is very much enlarged, and it is probable that in all cases, the gutta-percha point is to be preferred. Zinc chloride is a strong irritant, and if a slight amount is carried beyond the apex and into the tissues, it may set up an inflammation difficult to control, causing considerable pain and discomfort to the patient.

On the other hand, gutta-percha is an inert substance, and if a little is carried beyond the apex, the irritation caused by its presence is slight, and will soon pass away.

Another objection to the use of oxychloride of zinc as a canal filling, especially in any of the teeth anterior to the molars, is the difficulty of opening the canals so filled for the reception of a post, if at some future time it should become necessary to crown the roots. This difficulty, however, may be overcome to a certain extent, if after the canal has been filled with the oxychloride of zinc cement, before it begins to harden, a gutta-percha point is inserted and forced as far toward the apex of the root as possible. Indeed, it is a wise precaution to do this in all cases, when using oxychloride of zinc as a canal filling.

Filling Pulp Canals with Paraffin.—Paraffin is also advocated and used by some for filling pulp canals. The canals are thoroughly dried and a little iodoform or aristol is sifted into the openings of the canals. The paraffin is then carried into the canals with a fine heated broach. It is claimed that this makes a good root filling, especially in the lower teeth, but the writer does not recommend its use.

TREATMENT OF PERFORATED ROOTS.

A perforated root is a complication frequently encountered, and unless slight and favorably located it is at times quite difficult for the operator to decide what is best to do. If the perforation is large; if there has been much mutilation of the root or irritation of the soft tissues, or it has been of long standing, it may, perhaps, be best to remove the tooth or root. Each case, however, must be decided upon its own merits, with a strong leaning toward the forceps in all doubtful cases.

On the other hand, if the tooth or root is especially valuable to the patient, and conditions are favorable, it is best to make the effort, as it is sometimes possible to restore even a badly perforated root to a healthy state with a fair chance of its remaining so.

Where the perforation is recent, and there has not been much mutilation of the tissues, it can nearly always be treated and properly filled so as to render the tooth serviceable.

In all of these cases unless the perforation has been very recent it is quite likely that the soft tissues have grown into the cavity. This intruding tissue must first be removed by excision, or it may be cauterized with trichloracetic acid, carbolic acid, or iodin. Where the size of the growth is not great, the opening may be cleared by packing the cavity tightly with dry absorbent cotton. This will expand as it becomes moist, and will force the gum tissue out. At times gutta-percha may be used for this purpose, the cavity being tightly packed.

There are different materials which may be used for closing these perforations, such as gold, gutta-percha, oxyphosphate of copper, thin platinum or tin foil burnished over the perforation and then covered with one of the above, and lastly, copper amalgam.

In the experience of the writer copper amalgam has proven to be the most satisfactory material which can be used in such cases. The tissues seem to take more kindly to it than to any of the others, and if the work is done carefully, there will be practically no irritation. Many times, where everything else has been tried and failed, copper amalgam has proved most effective.

Manner of Treating Perforated Pulp Chambers or Canals.—The parts are first thoroughly sterilized and then a little adrenalin chloride may be left in the cavity for a few minutes, to check any hemorrhage or flow of serum, after which the cavity is thoroughly dried with alcohol.

Where there is a very large perforation in the floor of the pulp chamber it is well to lay a little piece of platinum in the form of a cross over the opening, as in Fig. 49, so as to prevent any excess of the amalgam from being forced through. This is then covered with the copper amalgam, using a broad faced burnisher and spreading it carefully over the floor of the pulp chamber, the sides of which have been previously undercut slightly so as to hold it. The mercury should be well squeezed out of the amalgam before putting it into the cavity.

FIG. 49

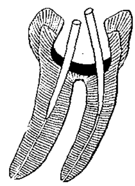


FIG. 50

The canals should also be kept free from the amalgam. If the perforation extends near them, pins, which have been oiled or wiped with vaseline or cocoa butter, can be placed in the entrance of the canals, and the filling smoothed into place, after which the pins may be removed, leaving the entrances to the canals free (Fig. 50). The copper amalgam at this stage being very soft, and also very slow setting, the teeth should be carefully protected and any further operation in the pulp chamber or canals should be postponed to a subsequent sitting. The amalgam may be covered lightly with temporary stopping, care being exercised not to use pressure enough to force any excess through the perforation.

Where the perforation is at the end of the root, it may be filled with a gutta-percha point, in the manner described in treating of filling pulp canals with enlarged foramen, or packed with copper amalgam, using a large instrument which will penetrate the root only to within about one-eighth of an inch of the apex.

Where there has been much inflammation, a dressing on cotton, composed of one of the essential oils and iodoform or aristol or tricresol and formalin may be kept in the canal until the soreness has passed away, when the root may be filled as already described. An excess of the oils or tricresol and formalin should be avoided, or it may act as an irritant. After dipping the cotton in the liquid, it should be squeezed in the folds of a napkin before applying.

Where the perforation is at the side of the root, if it be not far below the gum line, a small, thin, flat-ended instrument can often be passed under the gum and held to the side of the root, so as to cover the opening. With this in place, the amalgam can be packed into the perforation and against the instrument. When the opening is so located as to be inaccessible from the outside, a trial plug should be made for the perforation, showing the size of the opening and also giving an idea as to the amount of material which will be necessary to fill it. For this purpose, a piece of base plate gutta-percha is used, passing it into the canal, packing it carefully into the opening and forcing it through to the outer wall of the root. This plug is then removed and will give the size and shape of the perforation (Fig. 51). A little adrenalin chloride may be left in the cavity while the filling is being made ready.

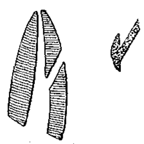


FIG. 51

A small piece of copper amalgam, slightly larger than the trial plug is now prepared. The cavity thoroughly sterilized and dried, and the sides of the opening grooved or slightly roughened, so as to hold the filling in place. The material is then packed into place and smoothed over carefully, so that no excess material is forced through the opening and into the tissues. It is then left to harden.

If it is desired to use gutta percha to close the perforation, the trial plug can be sterilized and shaped so that it will reach not quite to the outer wall of the root, leaving a slight excess on the inner side. The plug is then lightly fastened to the end of the instrument and placed in the opening and packed flush with the canal wall.

It should be remembered that if the root is to be banded, the amalgam should be kept within bounds so that it will be impossible for it to come in contact with the band.

FRACTURED ROOTS.

This is a troublesome complication and of somewhat frequent occurrence. It is often difficult to decide whether a root which has been split can be saved or should be extracted. The fracture of a root is often brought about by placing upon it an artificial crown without banding or protecting the root, and more frequently occurs in the incisors and bicuspids, than in the other roots.

In the majority of cases, where there is a bad fracture of long standing, and where the broken parts are widely separated, it will be necessary to remove the root, but sometimes it can be made to do good service, even when it has been split all the way to the apex. As an example an upper central incisor may be taken (Fig. 52). If the fracture is recent, and the parts are not much separated; so that the gum tissue has not crowded in between the broken parts, they can be brought together, and by crowning the root properly, it can be made to last for a number of years.

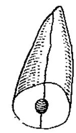


FIG. 52

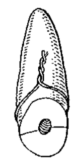


FIG. 53

As a preliminary, any tissue which may have worked in between the separated parts should be carefully removed and the opening washed out and thoroughly sterilized. To facilitate this, an instrument should be placed in the split and the broken halves forced farther apart, and after the cleansing are drawn together. This may be done by using a strong iron wire. The wire should be heavier than that used for taking the measurements of the roots, being about twenty-eight or thirty gauge in thickness and is placed over the root and forced under the gum, down against the process as far as possible. At times it may be necessary to slit the gum on the labial side in order that it may be placed far up on the root. The wire is twisted tightly on the labial side until the parts are brought into close contact (Fig. 53). After the parts are brought together, the excess of the twisted end of the wire is cut away and the remainder pressed upward close to the gum so that the sharp end may not injure the lip.

Frequently, a strong clamp placed over the root will assist very materially in bringing the parts in close contact, and the wire is passed under this and tightened. The root is then very carefully shaped and a tightly fitting band made for it with pin and floor complete. The band should be made of heavier material than for an ordinary crown and twenty-eight gauge of coin gold is here indicated.

The completed cap is then put in position, the impression taken and the crown completed. After the crown has been made, it is cemented to the root and when the cement has thoroughly hardened, the wire is removed. This renders the root perfectly firm, and if the work has been skillfully done, it may last for a great many years.

Where there is only a minor fracture of the root, the piece which is broken away can be removed and the band made to cover the line of fracture.

BANDING ROOTS WHICH HAVE BROKEN APART AND SEPARATED.

Cases are met with where the roots of broken-down molar teeth have separated from each other, but are still, individually, long and firmly set. If properly treated, many of these may be used to assist in supporting a bridge as well as though the entire tooth was standing.

Take the case of an upper molar, where the palatal root has become separated from the other two, as in Fig. 54. These roots

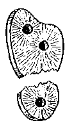


FIG. 54

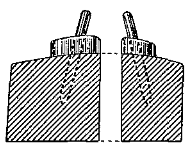


FIG. 55

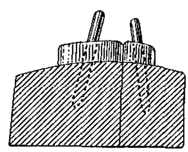


FIG. 56

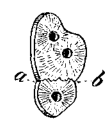


FIG. 57

should be brought together. The gum, however, must first be crowded from between and from around the sides of the roots, so that a clear impression of the outline can be obtained.

The canal in the palatal root and the canal of one of the buccal roots are enlarged as much and as deeply as possible and pins placed in them, and an impression taken.

A model is prepared from this and dried thoroughly. It is then trimmed, carefully cutting down the sides of the root and

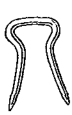


FIG. 58

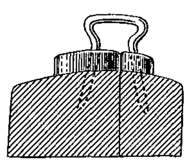


FIG. 59

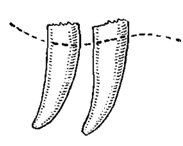


FIG. 60

across the line of fracture, care being exercised not to scrape the sides of the roots in the least. The plaster is then cut away from between the roots (Fig. 55), and the two parts are brought in contact in their normal position and held there by waxing or setting in fresh plaster (Fig. 56). A band is fitted to this plaster stump, carrying it well into the depression where the roots are constricted (Figs. 54 and 57).

The pins having been removed from the model, a staple of heavy round platinized gold, or clasp wire, with a large loop (Fig. 58), is then made and fitted in the canals, as shown in the model, so as to go in with a spring and hold the parts tightly together, as in Fig. 59. This staple is then pressed still closer together and is forced in the root in the mouth. The spring exerts a steady pressure and it will generally be found that in a few hours the parts have been brought into contact. The staple should be left in position for a couple of days after the parts are in contact so that the roots may become somewhat set in their proper position. The staple is then removed, the canals thoroughly cleansed and the staple reset with cement. The band is then placed on the stump, the impression and articulation taken and the crown finished in the usual manner. After it has been cemented, providing the work has been carefully done, the tooth will be practically as good as ever and will last for many years.

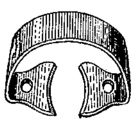


Fig. 61

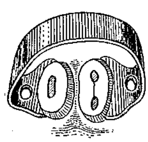


Fig. 62

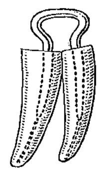


Fig. 63

Another case which is frequently encountered is where the two roots of a lower molar have become separated, at times, for quite a distance. If they are of good length and firmly set they can be utilized. If they are standing far apart (Fig. 60), it may be well to crown the roots separately and then build up any form of abutment to carry a bridge that conditions favor. If the distance is not very great, say, not exceeding one-sixteenth of an inch at the most, they can be treated in the same manner as advised for the upper molar. If they are standing well out of the gum they can frequently be brought more quickly together by placing a very strong clamp (Fig. 61) over them, and leaving it for a time (Fig. 62). This will help to bring the separated roots together, and after they are in contact they can be held in position with the staple in the manner already described (Fig. 63).

CHAPTER V.

RELATIVE STRENGTH OF THE TEETH AS SUPPORTS FOR BRIDGE-WORK.

THOSE who do crown and bridge-work should have a good understanding as to the relative strength of the different teeth, and what can be expected of them as supports in carrying a bridge. (The carrying capacity of the different teeth varies greatly, and it is important to know, approximately, what may be expected from each.)

For many years the writer has made a careful study of this subject with the view of determining just what may or may not be expected of the different teeth when serving as anchorages for bridge-work. He has made many observations under widely varied conditions, and has arranged a table for the upper and lower series.

Of course it is understood that conditions may exist which would cause a variation in the order as given, but where the conditions are normal the table will be found to be nearly correct.

Teeth in the Upper Jaw.—The teeth which may be considered as first in strength and endurance as abutments are the cuspids. These are followed by the first and second molars. It is perhaps a question as to which of these teeth, the molars or the cuspids, form the most permanent anchorages, but it is probable that the balance is rather in favor of the cuspids. After the first and second molars come the second and first bicuspids. It is really difficult to choose between these teeth, as under proper conditions each seems to do the work equally well, although, if there is any choice, it might perhaps be given to the second bicuspid.

Next in order come the central incisors, then the laterals and lastly the third molars or wisdom teeth. The third molars are placed last in the list on account of the uncertainty regarding them, and also their position being so far back in the mouth as to render them very difficult of access in devitalizing, treating, and in preparing them for the reception of the crowns and fitting of the bands. At times these teeth are large and strong and well rooted, and will serve as abutments, practically, as well as the other molars, lasting for a great many years, but on account of the uncertainty associated with them, they are placed at the end of the list.

Lower Series.—The strength of the lower series follows practically the same order as those in the upper, with the exception that here the lateral and central incisors are placed at the end of the list. The roots of these teeth are very small and frail, and they are placed last, notwithstanding the uncertainty associated with the third molars.

Form of the Arch.—The formation of the arch is an important factor in the carrying capacity of the teeth. A bridge which in one mouth might be of the utmost value to the patient, in another, where the conditions are seemingly the same, the teeth being equally good, but with a differently shaped arch, bridge-work might prove to be a detriment rather than a benefit.

Properly treated, a tooth can be made to do far more work than it was originally intended to do. One tooth may do the work of two or even three, under certain conditions, but these conditions must be carefully and conscientiously studied. It is impossible to lay down any fixed rules governing this point, and show just where bridge-work is or is not indicated. In two cases, which on first seeing may seem to be identical, there will be found some point of difference, such as occlusion, inclination of abutments, etc., which may necessitate the treating of one case in an entirely different manner from the other.

Frequently, a case may be presented which at first glance seems ideal for this kind of work, but on studying it carefully, will prove to be altogether unsuitable. On the other hand, a case, which on first thought seems unsuitable, may, after careful scrutiny, prove to be one of the best. To sum up in a few words, there are no two cases which are exactly alike and each must be carefully studied and decided upon its own merits.

THE STRAIN ON A BRIDGE OCCLUDING WITH A PLATE.

Whether a bridge is to occlude with natural teeth, or with artificial teeth on a plate, may properly have a deciding influence when considering its construction.

If the bridge is to occlude with teeth on a plate it can be made longer, and with weaker abutments, than would be safe were it to occlude with natural teeth, as the force of mastication is far less where a plate is worn than where the natural teeth are standing.

BRIDGE SUPPORTS.

When and Where Bridge-work is Indicated.—Although it is impossible to lay down any fixed rules governing this work, there are some typical cases which are frequently presented that will be considered.

Beginning with the simpler cases, take the anterior part of the mouth where one tooth is missing, for example an upper lateral, both of the adjoining teeth being in perfect condition. Now, in the majority of these cases, a small plate is used to restore the missing tooth, but the ideal fixture would be a small bridge anchored to the adjoining teeth.

In a bridge of this kind, it is necessary that the tooth serving as an abutment should be devitalized, and that tooth should always be the cuspid. The reason for this is not that the central is a weak tooth, for it would be amply strong to carry the dummy, but for very good reasons which will be given later.

It is rarely that it is necessary or advisable to cut off the crown of this abutment tooth, but by devitalizing it and using an inlay abutment, we preserve the natural crown and the bridge will, if the work be carefully done, last a long time.

There is an inflexible rule which should be followed in all cases of restoration with bridge-work whether it be of a single tooth or of a longer series of teeth. It is this, *always have at least two supports for a bridge.* Never trust to a single tooth to carry the dummy. Always provide some additional support at the opposite end of the bridge, if it has but a single retaining abutment, even though it be a slight one.

When the two lateral incisors are missing, ordinarily the two centrals will safely carry the dummies restoring the lost teeth, but if the teeth should seem weak or the arch V-shaped, additional support should be had in the way of a light spur resting against a small gold filling or inlay on the lingual surface of the cuspids. This will prevent the bridge from being forced labially.

Where the central incisors have been lost, the laterals will serve as abutments. It is best to cut them off and crown them, as these teeth are generally too weak and slight for inlay abutments, but they should receive additional support from the cuspids, as in the case of the missing laterals.

Where a central and a lateral, both of the same side, have been lost, as in Fig. 64, the central and lateral of the opposite side may serve as the main or retaining abutments, but they should have additional support from the cuspid in the way of a spur resting in a pit or groove in a gold filling or an inlay. In a case of this kind, the cuspid alone might serve as a retaining abutment with the spur resting on the lingual side of the remaining central.

Where the central and lateral of opposite sides (Fig. 65) are to be restored, the remaining central and lateral may be used with additional support from the cuspids, as above. In either of the above cases, if the lateral and central abutments are not very strong,

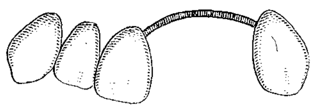


FIG. 64

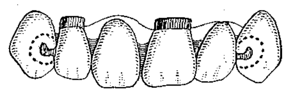


FIG. 65

one or at times both of the cuspids should be devitalized and utilized as retaining abutments, using inlays and pins, or if the bridge be removable inlays with tubes and split pins.

Where all of the incisors are missing, a lasting bridge may be made by using only the cuspids as abutments, providing these teeth stand well apart and the bridge can be made on nearly a straight line with the abutments, or with only a slight outward curve, (Fig. 66). Where the arch is V-shaped and narrow, so that when in position the center of the bridge will extend outward far

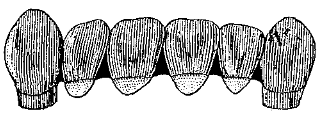


FIG. 66

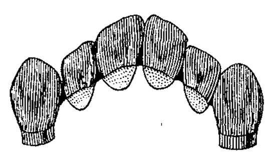


FIG. 67

beyond the line of abutments, as in Fig. 67, the leverage would be so great, if the cuspids only were used, as to force the body of the bridge upward and outward, thus carrying the cuspid roots forward, making a gradually increasing space between the upper and lower incisors and eventually loosening the cuspid abutments (Fig. 68).

With an arch of this shape, it is necessary to secure some additional supports. This can be done by utilizing the first bicuspids and giving them a broad occlusal surface. This will effectually overcome the tendency of the body of the bridge to move upward. In order to do this, it would be necessary to force the bicuspid abutments downward, the cuspids, which are always deeply set, serving as a fulcrum, and this would be impossible on account of their occlusion with the lower teeth.

In the case of a full denture there should be at least four good strong abutments. The two cuspids and a first or second molar on each side of the arch would form an ideal case for a minimum number of anchorages. A bridge of this kind should be made in one piece, thus making one side assist in supporting the other.

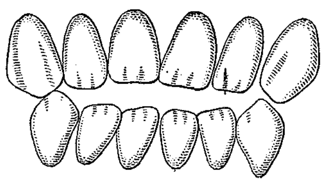


Fig. 68

Large Bridges One Piece or Divided.—If, with only the four abutments, the bridge is made in two parts, divided at the median line, the tendency will be for the two halves to be forced outward buccally, thus separating the parts and leaving an ever-widening space between the central incisors. If we increase the number of abutments, having the two central roots in position, then the bridge might be made in two sections divided at the median line. In a case of this kind, however, all of the abutments should be made parallel, as they would be if the bridge was to be made in one piece, so that if the parts ever showed a tendency to separate, they could be removed and connected by soldering, with the certainty that they would go easily into their proper position in the mouth after having been united.

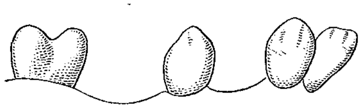


Fig. 69

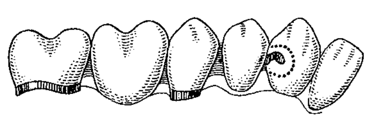


Fig. 70

It should be remembered that we cannot have too many supports, and that every additional abutment adds just so much to the chances of long life for the bridge.

Another typical case is where the first bicuspid and first molar have been lost, as in Fig. 69. In this case, ordinarily the second bicuspid and second molar would be sufficient as abutments, unless the bicuspid had moved back toward the second molar, so as to leave a much greater space than could be filled by a single bicuspid dummy; in which event the cuspid should be used as an additional supporting abutment as the increased leverage of the dummies would be too great a strain on the bicuspid abutment, Fig. 70. The same plan should be followed where the two bicuspids are missing and the two molars are used as abutments.

Where a single bicuspid or a single molar is missing, as a rule there need be but a single retaining abutment, but the other end of the bridge should have a support in the way of a spur resting in a filling or an inlay.

We might go on indefinitely giving instances where bridge-work might be used, but these few typical cases will serve as a guide for further operations of this character which may be encountered.

CONDITIONS MAKING FOR SUCCESS IN CROWN AND BRIDGE-WORK.

The success of crown and bridge-work depends entirely on the preparation of the teeth and roots. By this preparation, it is not meant simply the mechanical trimming for the reception of the bands or caps, but it begins at the beginning, the devitalization of the teeth and the cleansing and filling of the canals. If this is not properly done, bridge-work can never be a success.

A loose or diseased tooth does not necessarily preclude the idea of using it as an abutment for a bridge. There are many times where such teeth, by proper treatment, may be brought to a perfectly firm and healthy condition, and a tooth or root should not be sacrificed as long as there is the slightest chance of bringing it to such a state, but we should not decide definitely to use it until it is certain that a cure has been effected.

CHAPTER VI.

TYPICAL SHAPES OF THE TEETH. MECHANICAL PREPARATION OF THE TEETH AND ROOTS FOR THE RECEPTION OF THE BANDS.

The surgical treatment of the teeth having been properly carried out, the success of the work then depends upon the mechanical preparation of the teeth and roots for the reception of the caps or bands. In order to do this properly, it is necessary that the operator should thoroughly understand and be familiar with the anatomy of the teeth. A careful study should be made of the shapes of the different teeth as they would appear if cut off about one-sixteenth of an inch below the gum line.

It is an excellent plan for the beginner to take the different teeth and cut them off to about one-sixteenth of an inch beneath the gum line, or grind them until the contour is entirely removed to about that point, so that the band can pass over the stump and fit the root tightly. He should not confine his study to a single tooth of a given character, but should observe many, and note any variation from the typical shape. There is a typical shape to all of the teeth, and it is rarely that this shape will vary, probably not in 1 per cent. of all the cases encountered.

All of the teeth or roots, if properly prepared, present something of an oval or triangular shape, being broad on the buccal or labial side and narrower on the lingual or palatal side. This must, of necessity, be the case in order that they may be accommodated in the arch. The appended chart, Fig. 71, well illustrates this and will give an idea of their various shapes as they would appear when observed from the occlusal or incisal ends of the stumps or roots.

The cross sections are made at the extreme overlapping edge of the enamel or about one-sixteenth of an inch beneath the gum line, the distance to which the band is supposed to be carried on the root.

TEETH OF THE UPPER JAW.

In making a study of the teeth in the upper jaw, we find that the cuspids are nearly true ovals, or egg-shaped, being broad on the buccal and narrower on the lingual sides.

The shape of the lateral incisors is almost an exact reproduction of the cuspids but of course being very much smaller.

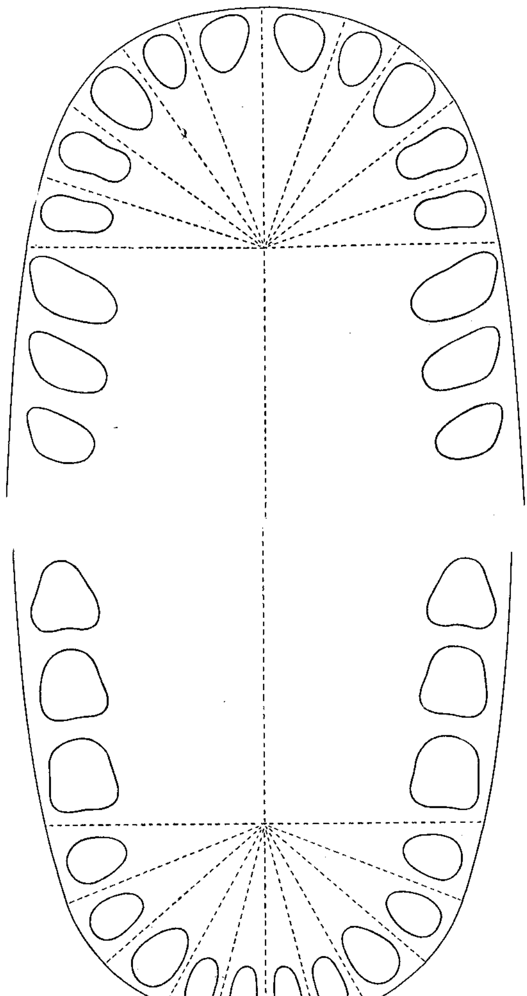


Fig. 71

In the first bicuspid, while it still preserves the same general oval shape, it will be seen that it is much broader buccally and lingually proportionately, than are the cuspids, the buccal and lingual diameter of this tooth being nearly twice as great as the mesial and distal. After the contour has been entirely removed from this tooth to about one-sixteenth of an inch below the gum line, it will be found by following the curve of the buccal and lingual sides of the root and completing the circle on each of these sides, that there will be two perfect circles, the lingual being slightly smaller than the other (Fig. 72).

The second bicuspid root is practically of the same shape as the first, the only difference being that the second bicuspid root will be slightly smaller than the first, but the proportionate mesial distal and buccal and palatal diameters remain practically the same.

In the first molars, this triangular shape is still preserved, but as in the case of the bicuspid, the buccal and lingual diameter is usually

FIG. 72

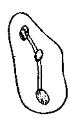


FIG. 73

about twice as great as the mesial and distal, being broader on the buccal side, where we have the two buccal roots, and narrower on the lingual, where there is but one. This may vary at times, and the tooth be as broad, or even broader on the lingual side, when there is an excessively large palatal root and the disto-buccal root sets well inside of the arch between the mesio-buccal, and palatal root as in Fig. 73, but this is an abnormality and very rarely occurs. It will always be found that the distal root sets considerably farther inside the arch than does the mesial, thus giving the stump a more distorted appearance.

The second molar presents the same general shape as in the case of the first, but the stump is proportionately a little shorter buccally and lingually than is the first molar.

Very rarely the first or second molars have but a single root and then again, at times, they may have four. In the latter case, the palatal side will nearly always be broader than the buccal, as the two palatal roots usually follow the curve of the arch more nearly than do the buccal roots, and stand side by side mesially and distally, one directly behind the other (Fig. 24).

With the third molar, or wisdom tooth, if it has the normal number of roots, it will have the same general shape as in the other two molars, but this will be still smaller proportionately, buccally and lingually, than the second, being more nearly round than are the others. However, the shape of this tooth is subject to a greater variation than are any of the others, as it may have but a single root or at times even as many as five or six.

The central incisors, have still the same general ovoid form as the others, but somewhat distorted. This root has more the general outline of the molars, but is proportionately very much shorter labially and lingually, and is decidedly triangular in shape. If these teeth are properly set in the arch, there will be a V-shaped space between the two roots lingually. The distal sides of the labial face of these roots, as in case of the molars, set a little farther in the inside of the arch than does the mesial.

TEETH OF THE LOWER JAW.

In the lower jaw we find the central incisors still preserving their oval character, but decidedly different in shape from the upper, being proportionately much longer labially and lingually than are the centrals in the upper. These roots are very small and as a general rule are of little value as supports in bridge-work.

The lateral incisors are practically of the same shape and character as are the centrals, but somewhat larger, and while not of particular value as supports for a bridge, still they are much better than are the centrals. The shape of both of these roots, is often very much like that of the upper second bicuspids, and at times the labiolingual diameter is nearly twice that of the mesial and distal.

The cuspids, as in the upper, are nearly true ovals, but the lingual corner is generally much sharper than is the case with the upper cuspids.

The first and second bicuspids are also nearly true ovals and both practically of the same shape, the first being slightly smaller than the second, but the lingual side is proportionately broader and rounder than are the cuspids.

The shape of the lower molars is very different from that of the molars in the upper jaw, but they still tend to the oval.

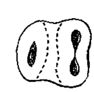


Fig. 74

First Molars.—This tooth is more nearly square, being broad and nearly flat on the mesial side, the same on the buccal and lingual, the lines converging slightly toward the distal, while the distal side is more convex owing to the difference in the shapes of the roots (Fig. 74). The mesial root is almost exactly the same in character and shape as the upper second bicuspid root, the buccal and lingual diameter being about twice that of the mesial and distal, while the distal root is more rounded than is the mesial. If there has been a recession of the tissues there will be a slight depression on the mesial side of the stump where the root is constricted, and also on the buccal and lingual sides where the roots begin to bifurcate (Fig. 74).

The second molar presents the same general shape, but the distal root is smaller, making this tooth slightly narrower proportionately on the distal side than is the first molar.

With the third molar, if they have the normal number of roots, the distal root is still smaller, the prepared stump often forming an almost perfect triangle, with the corners rounded. As is the case with the upper wisdom tooth, however, the shape of this tooth is subject to more variation than are the others, as they may have but a single root or they may have several.

The foregoing is a fairly accurate description of the shapes which the stumps of the different teeth will present after they have been properly prepared for the reception of bands. If we carry these shapes in mind, we will find that the work of trimming will be very much simplified. In trimming, we are always working toward the typical shape and being familiar with these shapes will materially aid us in the work of preparation and will also enable us more readily to detect any variation from the typical formation.

TRIMMING OF THE TEETH.

Wherever bridge-work is used, it is necessary that the teeth or roots, which are to serve as abutments, should be reinforced as much as possible in order to give strength and stability to the abutments, and also to overcome, as far as may be, the possibility

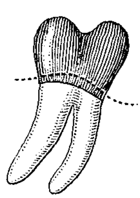


Fig. 75

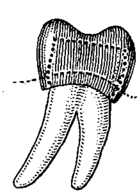


Fig. 76

of their being fractured. In order to accomplish this result, it is essential that the roots should be banded. To do this properly, the contour of the tooth must be entirely removed, so that the band, when it is passed over the crown of the tooth, will hug the neck tightly, and reduce the possibility of gingival irritation to a minimum

(Fig. 75). If this contour is not removed, the band will stand away from the root, cut into the tissues and set up an irritation which may eventually result in the loss of the tooth (Fig. 76).

In all of the teeth the bulk of the trimming will be on the mesial and distal surfaces, the contour of the crown being greatest at the points of contact with the adjoining teeth, and gradually diminishing as we approach to gum line, until at a point about one-sixteenth of an inch beneath this line, or at the overlapping junction of the enamel with the dentin, it entirely disappears.

Trimming of Lower Molars.—In taking up the technic of the preparation of the teeth for the reception of the bands, the preparation of the lower first or second molar will be first considered.

Viewed from the buccal or lingual sides, the contour of these teeth is very great. The mesial and distal diameter at the point of contact with the adjoining teeth is from one-third greater to, at times, even twice that which it is at the neck, or about one-sixteenth of an inch

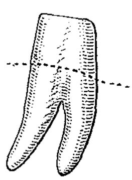


FIG. 77

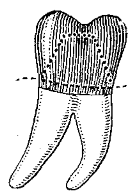


FIG. 78

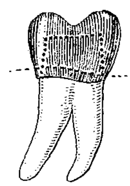


FIG. 79

below the gum line, at the point of junction of the enamel with the dentin. Viewing them from the occlusal surface, they are oblong, generally being slightly broader at the mesial side than at the distal side.

The teeth should be trimmed so that the sides are very nearly parallel, being slightly larger at a point about one-sixteenth of an inch beneath the gum line (Fig. 77). It is very necessary that the stumps should not be made too conical, as if this is done, there will be very little hold for the crown which is to be placed on it and after being cemented it would require but a slight blow or strain to loosen it (Fig. 78). On the other hand, if the sides are nearly parallel, a very strong retention is obtained and it would require a greater strain than is ordinarily brought to bear on the teeth to loosen the cap from its position (Fig. 79).

In order to give the teeth the desired shape, it is necessary to have instruments of suitable design, so that the work of preparation may be performed easily, and at the same time with as little pain and inconvenience to the patient as possible.

The trimming of these teeth cannot be done with a hand-instrument, as the bulk of material which must be removed, in order to allow the passing of the band, is so great that if sufficient force were exerted to strip the enamel or contour from the tooth, it would be great enough to remove the tooth from the socket, so that the only way to remove it is by grinding.

It is impossible to prepare these teeth with a straight flat-faced wheel, so that they will be parallel with an anterior abutment, as in order to remove the contour entirely on the mesial side, it is would be necessary to cut far back toward the center of the tooth,

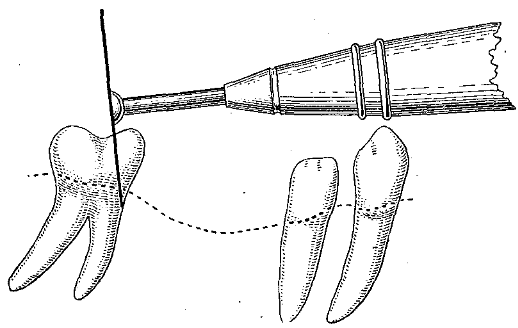


Fig. 80

thus giving it a backward slope from the gum line (Fig. 80). Furthermore, to remove the contour from the distal side with a straight, flat-faced wheel would necessitate cutting forward and into the distal root, leaving a ledge which would render the fitting of the band

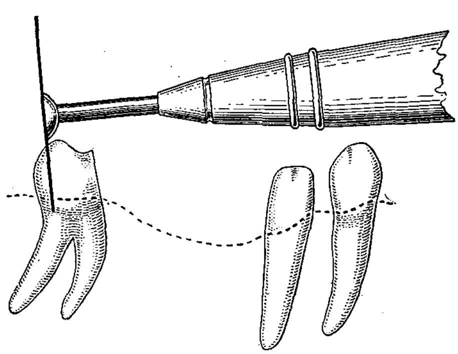


Fig. 81

extremely difficult (Fig. 81). This trimming is best done with a saucer-shaped disk, as shown in the illustration (Fig. 82). With this the sides can be reached from almost any angle, the contour easily removed, and at the same time the parallelism with the anterior abutment preserved.

The wheels which have been found most suitable in these cases are the Leaming disks, or wheels of the same design. These Leaming disks are made of carborundum and vulcanite, are very uniform in texture and are much superior to the ordinary carborundum wheels, as they will wear evenly and remain perfectly round and true until they are worn away entirely to the hubs.

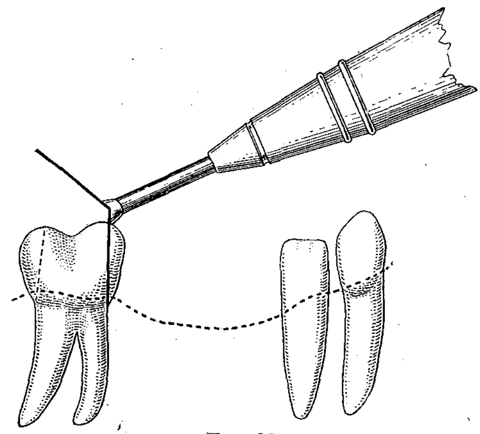


FIG. 82

The disk, which is used most frequently, is known as No. 421, (Fig. 82). This disk is very thin and of an equal thickness from center to circumference. This disk is suitable only for cutting on its edge as it is very thin and continued pressure on either the face or reverse side is liable to break it off at the hub.

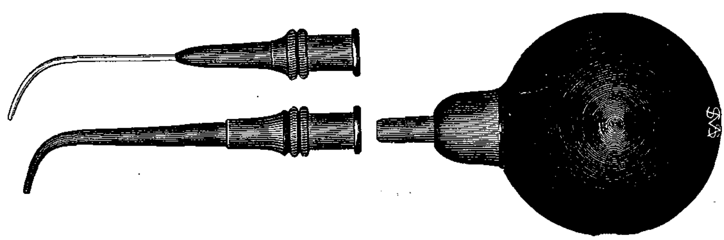


FIG. 83.—Bulb syringe.

The wheel and tooth should be kept constantly flooded with cold water, preferably iced. This can best be done with a syringe small enough to be held in the left hand, at the same time leaving some of the fingers free to hold the lips or cheek out of the way of the wheel. A small bulb syringe is most suitable for this purpose (Fig. 83).

There are appliances made for keeping the wheels wet which are attached to the hand-piece, the water being carried through a tube to the wheel (Fig. 84), but generally these are not as satisfactory as the ordinary syringe; as they are in the way of the operator and do not allow of a firm grasp on the hand-piece. When an assistant is employed at the chair, the operator can hold the lip or cheeks away with a mirror or other suitable instrument, while the assistant drops the water.

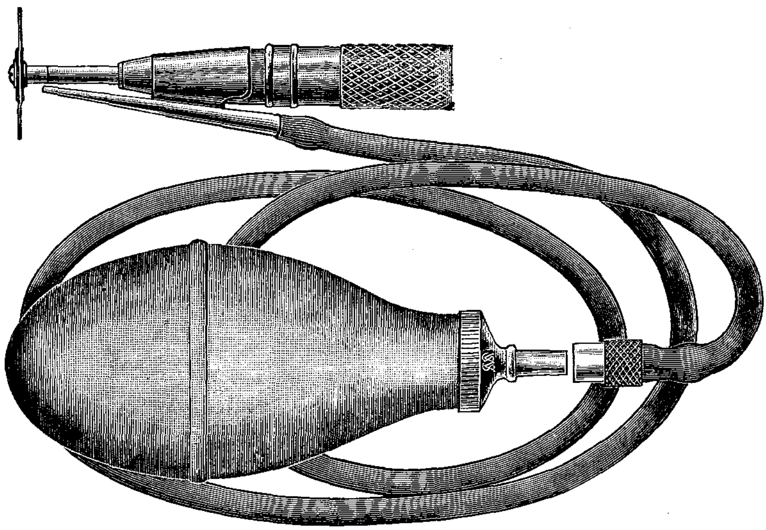


FIG. 84.—Devised by Dr. C. E. Edwards.

The tooth is examined carefully with an explorer in order to determine the approximate amount of tooth structure which will have to be removed. The edge of the wheel is then placed on the occlusal surface at just about the point determined by the explorer, and the bulk of the contour can be removed in one piece (Fig. 82).

The hand-piece should be firmly held so that it is impossible for it to escape from the control of the operator. It is grasped between the thumb, and the first and second finger of the right hand. In working in the lower part of the mouth, the third and fourth fingers are braced firmly against the anterior teeth in the lower jaw, as in Figs. 85 and 86. In this manner the instrument is held perfectly steady, and should it become jammed between the teeth, the wheel might be broken, but could hardly escape from the operator's control so as to injure the tongue or cheek of the patient.

By working in this manner, the operator has absolute control of the instrument and the firm grasp will inspire his patient with confidence in his ability to do the work with the least possible injury to the soft tissues.

If the dentist be left-handed, the method of work just described should be reversed.

Trimming the Lower Molars.—*Mesial Side.*—In trimming the lower molars, there are three principal cuts to be made (see Fig. 87). The first, and generally the greatest, is on the mesial side of the tooth. The second is on the distal side while the third is on the lingual side. These cuts should be made in the order here given.

FIG. 85.—Shows the position of the hands and instruments in trimming the teeth in the lower left side of the mouth, while Fig. 86 shows the position in working on the right side.

The explorer shown in the illustration (Figs. 88 and 89), is most suitable for use while trimming the teeth, as it is so shaped that every part of a tooth is easily accessible to it and the sides of a very long tooth can be reached to, or even beyond, the gingival border.

Mesial Side.—In grinding, the hand should be held very steady and the wheel must not be forced, but should be allowed to work its way through the tooth with little more pressure exerted than that which the weight of the hand-piece gives to it. This is continued until the contour on the mesial side of the tooth has been removed (Fig. 90). If on examination with the explorer, it is found that not quite enough of the tooth structure has been taken away, and that there still remains a little shoulder, as shown in the illustration (Fig. 91), the use of another wheel is indicated. This wheel is known as No.

FIG. 86

422 (see Fig. 91) and is of the same make as No. 421. It is saucer-shaped, as is the other, but as seen by the illustration, that while it comes down to a fairly sharp edge, it thickens gradually as it approaches the hub, and is made of a coarser material. It is much stronger and cuts more rapidly than does the No. 421. The wheel being thick and strong, the face or reverse side of it can be used.

The shoulder left after using the fine wheel should be examined in order to determine just about how much more material it is necesary to take away. The face of this wheel is then placed against the tooth, the same angle being preserved as with the first wheel, and the face of the tooth cut back until the explorer shows that we have gone the required distance (Fig. 92).

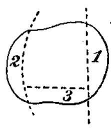


Fig. 87

Fig. 88

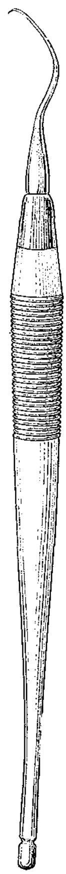


Fig. 89

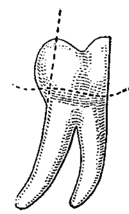


Fig. 90

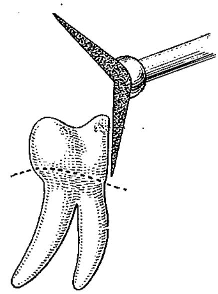


Fig. 91

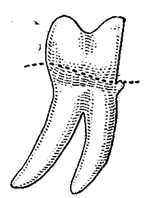


Fig. 92

This will leave a little ledge, because this wheel should not be used for cutting below the gum line, as its thicker edge and coarser material would mutilate the gum unnecessarily.

The thin disk, No. 421 with which the first cut was made is then used, placing the edge of the wheel on the ledge and cutting to the required depth beneath the gum line. The explorer is now used and should pass freely under the gum, and smoothly along the root. If it is found that it is the least bit too full, the cutting should be continued until it is perfectly flush and smooth with the side of the root.

It should be understood that to trim the teeth properly it is necessary to mutilate the gum tissue more or less. If the contour is entirely removed it is necessary to cut to a sufficient depth beneath the gum line and the loss of a little blood should occasion no alarm. There is no tissue in the body which heals as quickly as the gum tissue. In a perfectly healthy mouth, even where the gum has been quite badly mutilated, the tissue will be found entirely healed in a few days. It is absolutely essential in all of these operations that the instruments be perfectly sterile.

By using ice-water freely, in fact to have pieces of ice in the glass from which the water is taken it will act as a partial local anesthetic for the time being, so that the cutting beneath the gum can be accomplished with much less pain to the patient than it would be otherwise.

Distal Side.—The mesial side having been satisfactorily finished, the second principal cut in the trimming should be undertaken (Fig. 87). This cut is made with the same wheel or disk as was used in trimming the mesial side.

It should be remembered that the distal roots of these teeth are more rounded than the mesial. If the hand-piece be held perfectly steady in grinding down this side, owing to the shape of the wheel the distal surface of the stump would be ground concave rather than convex. This can be overcome by giving the hand-piece a to and fro sidewise motion following the outline of the root, determining with the explorer whether it has been done accurately. This should be carefully watched, and the grinding continued, using the same motion, until the instrument shows that the contour on this side of the tooth has been entirely removed.

Trimming of the Lingual Side.—The natural inclination of these teeth is lingually, as will be seen in the illustration (Fig. 93), and in making this third cut they should be ground so that the lingual side is nearly perpendicular.

In removing the lingual contour, it is best to stand on the side of the patient on which the tooth to be trimmed is located. If the tooth is standing by itself, a thin flat disk (Fig. 93) may be used, and nearly the whole amount of the contour removed with one cut, starting from the occlusal surface in the manner already described in the trimming of the mesial side (Fig. 93). The trimming of this side should be carried well below the gum line, perhaps even further than on the mesial or distal sides.

A smaller wheel of a different shape may also be used for this purpose, and also to complete the trimming, after the bulk of the contour has been removed. This wheel, one of the Leaming set, is of an inverted cone-shape and known as No. 500 (Fig. 94).

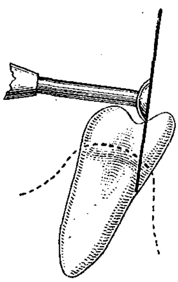


Fig. 93

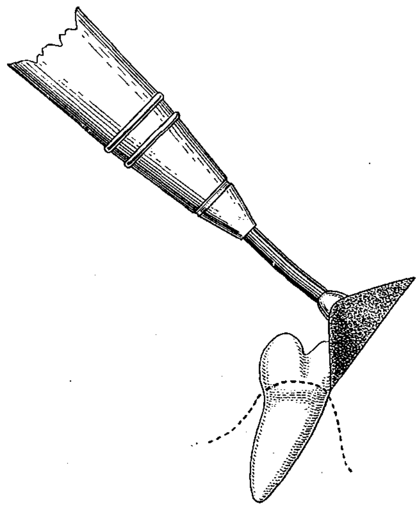


Fig. 94

If there is an adjoining tooth, great care must be exercised so as not to mutilate it, and in that case, we would use the reverse side of the No. 500 throughout the trimming of this surface (Fig. 94).

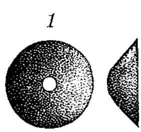


Fig. 95

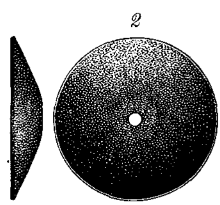


Fig. 96

There are diamond disks made to correspond in shape with these wheels, which work beautifully. The disk No. 1, Fig. 95, corresponding in shape to the No. 500, can be used wherever the No. 500 is indicated.

The disk No. 2, Fig. 96, of the shape of the No. 421, will take the place of the carborundum disk of that number and also of the No. 422, as it is made of copper charged with diamond dust, there is no danger of the disk being broken when using it on its face or on the reverse side.

The initial cost of the diamond disks is much greater than that of the carborundum and vulcanite, but as they will last a great deal longer they are perhaps the cheapest to use in the long run, as one of them will probably outwear a dozen or more of the others and will not break should it become jammed.

Buccal Side.—The three sides of the tooth having now been completed, there remains the buccal side to be trimmed.

As will be seen from the illustration (Figs. 93 and 94) when the lingual contour has been removed so that this side of the tooth is nearly perpendicular, there is very little tooth structure to be removed from the buccal side and at times, if the lingual inclination of the tooth is excessive, there may be nothing at all. The little that may have to be removed can be taken away with the reverse side of the inverted cone, No. 500. It is most easily reached from the opposite side of the mouth, grinding away a little at a time, using great care not to cut too much, as should this happen it will leave a shoulder or ledge under the gum over which the band must pass, thus making the fitting of the band a very difficult operation. It will be found necessary to remove a little more structure toward the distobuccal side, as the buccolingual diameter of the distal root is somewhat less than that of the mesial.

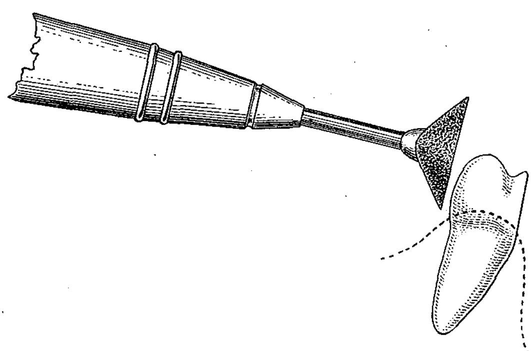


Fig. 97

At times, where the mouth is large or the cheeks are very flexible and can be drawn well back, the trimming of this side of the tooth can be done with the flat face of the No. 500 wheel (Fig. 97), or the face of a small flat disk, working from the side of the mouth on which the tooth is located (Fig. 98), using, of course, extreme care to protect the adjoining teeth.

The trimming of the four sides of the tooth having been satisfactorily completed, it will be found that the stump is nearly square, being slightly narrower on the distal side than on the mesial and it should also be slightly conical, being a little larger just below the gum line. The operation is completed with the rounding of the corners.

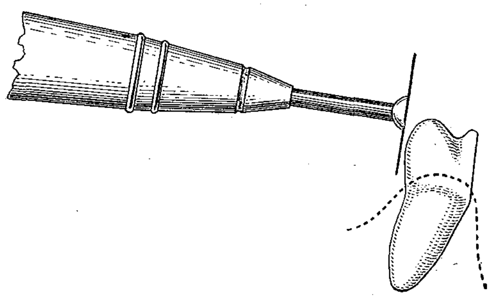


FIG. 98

The mesio-lingual corner can be reached by using the No. 421 disk or the diamond disk corresponding to that number, working from the opposite side of the mouth and giving a rotary or swinging motion to the hand-piece, being careful not to cut too deeply into the stump so as to leave a ledge.

The mesio-buccal corner can be reached with the same wheel or with the face of a small flat disk, using the rotary motion and carefully following the curve of the root at that point.

In trimming the distal corners, if the tooth is standing alone, they can be easily rounded by using the reverse side of the No. 500 wheel and giving it a rotary motion sweeping around the corners from side to side. If there is a tooth adjoining the one which is being trimmed, it will be necessary to use more care in grinding. A part of this corner contour can be removed by using the reverse side of the inverted cone, going as nearly to the gum line as possible without cutting the adjoining tooth. After the operator has taken away all that he can with the disk, it will be necessary to remove any corners or points remaining with scalers, or other suitable hand-instrument.

The diamond disk corresponding to No. 500 can be mounted on a suitable mandrel with the face or concave side of the disk outward, and if used in the right-angle hand-piece, the distal corners can be finished to a sufficient depth beneath the gum line, so that there will be no necessity for using the hand-instrument.

Very coarse emery cloth disks will be found to be a great help in rounding and finishing the distal corners of these teeth, after they have been roughed down with the carborundum or diamond disks. These are also especially useful where there is an adjoining tooth standing distally to the one which is being prepared. Their flexibility renders it possible to follow the rounded corners of the roots and at the same time, as they are safe-sided, there is no possibility of injuring the face of the tooth behind it.

Where there is a very great forward inclination of the molar, as is so frequently the case, where teeth anterior to it have been lost for some time, as in Fig. 99, there will be little or no cutting

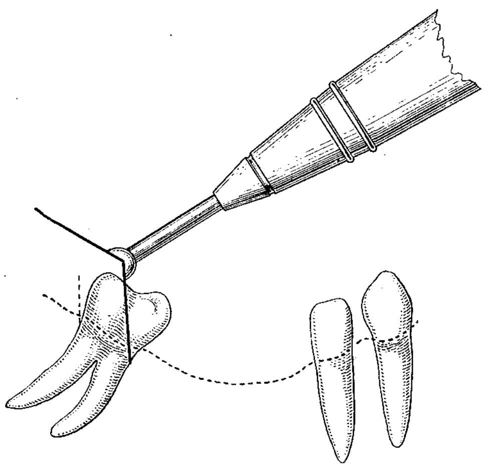


FIG. 99

necessary on the distal side of the tooth. All of the trimming, will be on the mesial side. The tilting of the tooth so far forward will allow of the band being passed perpendicularly over the crown of the tooth, clearing the enamel on the distal surface and striking the neck of the tooth beneath the gum line, as in Fig. 99.

The same wheel should be used for grinding the mesial surface of the tilted tooth, as would be used were the tooth to stand in normal position. In such cases it is necessary to start far back to or beyond the center of the tooth and cut well below the gum line on the mesial side, even farther than it would be, were the tooth standing upright so that if the band were the fraction of an inch longer than necessary it would not pass beyond the trimmed side of the root and leave a sharp edge cutting into the tissues, as the inclination of the root is such that there would be a very decided overhanging ledge at any depth on the root to which we might grind (see Fig. 99).

FIG. 100.—Shows the position of the small cup-shaped disk in trimming the distal side of the lower bicuspids or molars.

The buccal and lingual surfaces of the tooth are trimmed in the manner already described, using the same instruments as where the tooth stands in normal position.

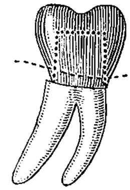


FIG. 101

It should be remembered that it is better to overtrim a tooth than to undertrim it. If too much of the contour is removed, so as to leave a ledge beneath the gum, so that the band cannot pass over it, the band can rest on this ledge and do very little harm (Fig. 101); whereas, if undertrimmed, the band will stand away from the neck of the tooth below the gingival margin and with the ragged line of cement may set up an irritation which will eventually result in the loss of the tooth.

Lower Bicuspids.—In trimming the bicuspids, the same methods and wheels may be used as in trimming the molars, using the edge, face and reverse side of the wheels. The mesial and distal contour of these teeth may often be removed in one piece, as in the case of the molars; but it frequently happens that the contour is not sufficient to allow of this. In such cases the operator should cut down between the teeth carefully and remove the contour very

FIG. 102.—Shows the manner of using the small cup-shaped diamond disk in the right angle hand-piece in trimming the buccal side of the bicuspids and molars.

gradually, using the No. 421 disk. The No. 500 can be used for the lingual and buccal sides. The greater amount of contour here, as in the case of the molars, is on the lingual side, but proportionately not so great as in the case of the molars.

The mesio-lingual corners of the lower bicuspids are the most difficult to reach, and in many instances it may be necessary to use a scaler to remove the tooth-structure at these points which has been left by the wheel. However, the diamond disk corresponding to the No. 500 used in the right angle, will very materially assist in the operation, held in the same manner as in Fig. 102.

The mesio-buccal corners can be best rounded by using the face of very thin, small flat disks, and giving the hand-piece a rotary motion. The trimming of the distal corners should be done the same as in the molars, using the reverse side of the No. 500 wheel and rotating to follow the curve of the root. In case there is an adjoining tooth, the scalers or the inverted cone diamond disk may be used in the right angle.

FIG. 103.—Shows the same instrument in the right angle trimming the lingual side of the lower bicupsids.

The Upper Molars.—The shape of the upper molars is very different from that of the lower molars, although as in the case of the lower molars, the greatest amount of tooth structure to be removed is from the mesial and distal surfaces.

The crowns of the upper molars, viewed from the occlusal surface, are diamond-shaped, the greatest diameter being from the anterior, buccal corner to the posterior palatal (Fig. 104). The same wheels may be used in their preparation as were used in the preparation of the lower molars.

As in trimming the lower molars, there are three principal cuts to be made, mesial, distal and buccal (Fig. 105).

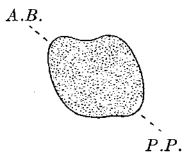


FIG. 104

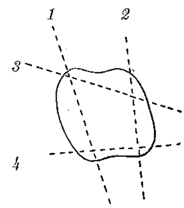


FIG. 105

Mesial Side.—The first cut is on the mesial side of the tooth, and the bulk of the contour will be found at this point, being slightly greater than that on the distal side. The first cut should be made

FIG. 106

with the No. 421 carborundum or with the diamond disk of the same shape. The bulk of the contour can be removed with a single cut.

In trimming the right upper molars, the third and fourth fingers are braced on the lower anterior teeth in the manner shown in the illustration (Fig. 106).

In grinding the left upper molars, the third and fourth fingers are braced on the lingual surfaces of the upper anterior teeth (see Fig. 107).

If an examination shows that a sufficient amount has not been removed, wheels of the same character can be used as on the lower molars, cutting back for a distance at the gum line with the No. 422 or diamond disk, and finishing with the No. 421.

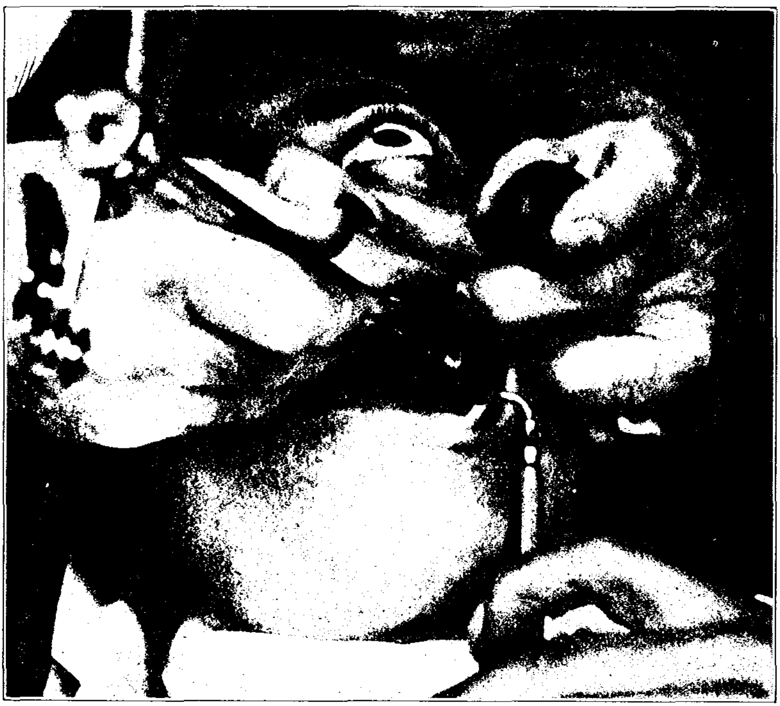


Fig. 107

Distal Side.—The distal side of the upper molars, unlike that of the lower molars, is nearly flat. The contour on this surface can be removed with the No. 421, or the diamond disk, rotating the hand-piece slightly from side to side, but not so much as in the case of the lower molars.

If the tooth has extruded or the gum has receded around the neck, it will generally be found necessary to groove this surface slightly midway between the buccal and palatal sides, in order to allow the band to be bent in at this place, so that it will hug the root at the point where the roots begin to bifurcate.

Disto-buccal Side.—The third principal cut will be on the disto-buccal corner. The distal root, setting further inside the arch than the mesial, the contour is consequently greater at that point. The removal of the contour from the distobuccal side may be accomplished with the No. 500 or diamond disk, using the reverse

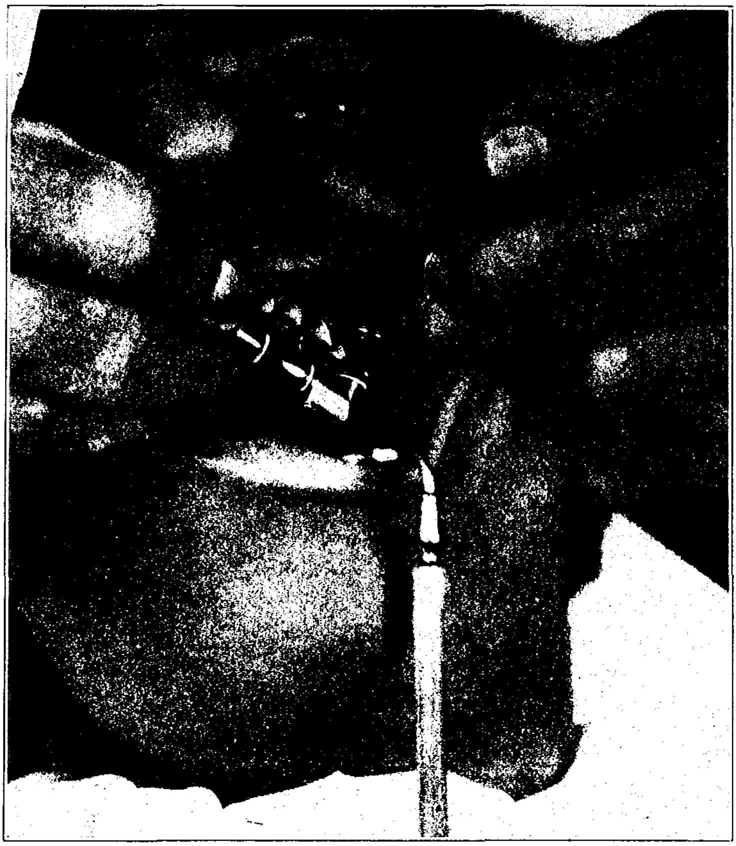


FIG. 108.—Shows the manner of using the small diamond disk in the right angle hand-piece in making this cut.

side and working from the opposite side of the mouth, giving a slight rotary motion to the hand-piece, or with the diamond disk used in the right angle hand-piece, care being used not to cut too deeply (Fig. 108).

Mesio-buccal Side.—On the mesio-buccal corner it will be found that there is very little, and at times nothing at all to be removed, as frequently there is practically no contour at this point, the root at the gingiva being nearly flush with the crown of the tooth. This necessitates only the rounding off of the sharp corner, which can be done with the face of a thin flat disk, rotating from side to side, using care not to cut into the root so as to leave a ledge, as a ledge at this point would render the fitting of the band much more difficult.

Palatal Side.—On the palatal side it will also be found that there is very little contour (Fig. 109) and that it can be removed with the reverse side of the No. 500 wheel or diamond disk, working from the side of the mouth on which the tooth is located,and rotating to follow the curve of the palatal root

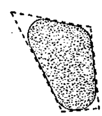


Fig. 109

The corners may be rounded with the wheels of the same character as were used on the lower molars, using the No. 421 or diamond disk for the mesio-palatal, with the rotary motion, and the reverse side of the No. 500 for the distal corners. The emery cloth disk will also be found useful in rounding and smoothing the distal surfaces and corners.

Upper Bicuspids.—The bicuspids of the upper jaw, wherever a shell crown is indicated, which is rarely, are prepared in the same manner as are those of the lower, the same character of wheels being used. The corners of the upper bicuspids are much easier to get at and trim than are those of the lower jaw, and the bulk of the tooth structure left at these points by the wheel can generally be easily removed with a hand instrument.

In cutting off the occlusal surface, enough of the tooth structure should be removed to allow of the placing of a thick solid cusp. Usually there should be not less than one-sixteenth of an inch between the top of the stump and the occluding teeth. This can readily be ground away with a square-edged carborundum or corundum wheel. The corners at the occlusal surface should be rounded slightly and smoothed so as to prevent their cutting the tongue or cheek.

If, for any reason, after the teeth have been prepared and ready for the impression, the bridge cannot be placed in the mouth for some weeks, as would be the case if the patient were leaving the city for a time, it would be better to leave the occlusal surfaces of the teeth intact. The bands are placed in position, and the impression taken.

The models are then prepared and after the bands have been removed, the occlusal surfaces of the abutment stumps on the models are cut away to a sufficient depth.

The bridge is then completed, and when the patient returns, before undertaking to place the bridge in the mouth, the occlusal surfaces of the stumps are ground away to a depth corresponding to that which has been removed from the model.

It very frequently happens, where the teeth have been trimmed and the occlusal surfaces ground away, that the irritation necessarily attending their shaping will cause these stumps to elongate very rapidly, or shift their position, so that if several weeks have elapsed between the taking of the impression and the placing of the bridge they may have extruded so far as to be in contact with the occluding teeth. This would necessitate the further grinding of the occlusal surfaces, with the result that, from the necessity of the band passing so much farther on the stump than it did originally, the fit at the gingival end might be impaired or entirely destroyed.

By leaving the cusps intact, however, the danger of the teeth elongating is entirely overcome, and at the same time, the cusps interlocking with their antagonists, the teeth are held in their original position and prevented from shifting.

Trimming the Anterior Teeth.—In the preparation of the anterior teeth the work should be done almost entirely with hand instruments.

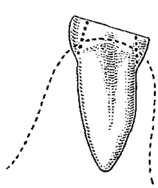


Fig. 110

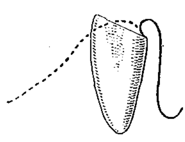


Fig. 111

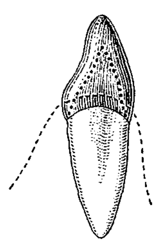


Fig. 112

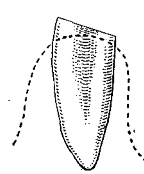


Fig. 113

When trimming these teeth, the stump should be left standing out of the gum for from one thirty-second to one-sixteenth of an inch, until after the contour has been entirely removed, and the band has been fitted (Fig. 110). The reason for this is as follows:

If the root be cut at once below the gum line, as it will be eventually, in order to hide the band when the crown has been completed and put in place, the gum will crowd over the face of the root (Fig. 111). This, and the excessive bleeding which is sure to occur, will interfere with the vision and render the operation of trimming much more difficult for the operator and decidedly more painful for the patient. The taking of the measurement of the root is rendered much more difficult and at times practically impossible, especially if there has been a great deal of recession of the gum on the labial side.

The difficulty of fitting the band is greatly increased, as each time the band is placed over the stump, it is necessary to crowd the gum

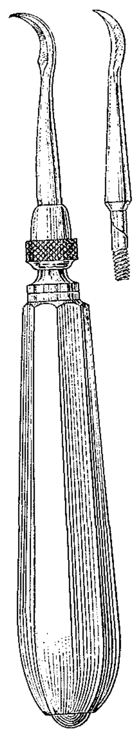


FIG. 114

FIG. 115.—Enamel scaler.

away in order to place it, so that on the whole it is very disagreeable and unsatisfactory to both patient and operator.

Where the stump is left extending out of the gum, it serves as a guide for the instrument in trimming and enables the operator to see much more clearly just what he is doing. It also serves as a guide in taking the measurement and in fitting the band by keeping the gum away, and enabling the fitting to be done better and much more quickly, and with far less pain to the patient.

After the band has been fitted, it may be removed and the stump cut to any desired depth below the gum line, after which the band can be replaced on the root and scribed around on the inside at the top of the stump, so that it may be trimmed to the proper length.

The maximum diameter of the root is at the point of junction of the enamel with the root, and this diameter generally continues

FIG. 116.—Shows the trimming of the lingual, mesial, and distal sides of the right cuspid root.

about the same for from one-sixteenth to one-eighth of an inch below the enamel before the root begins to taper (Fig. 112).

If this enamel is entirely removed, it will be found that the root is of about the proper shape for the reception of the band so that it will hug the root tightly (Fig. 113) unless there has been an excessive recession of the gum, in which case it would be necessary to do some cutting on the root itself.

The bulk of this enamel can always be removed with scalers or enamel cleavers, and it is very rarely that any other instruments need be used.

The most useful instruments for this purpose are an enlarged special No. 3 scaler (Fig. 114) and also the No. 7 scaler, which is of a slightly different shape and much thinner (Fig. 115).

FIG. 117.—Shows the trimming of the labial and aproximal sides of the right cuspid root.

These instruments should have large handles in order that the operator may hold them with a firm grip and have perfect control of the instrument so that there is no possibility of its slipping, or twisting in the hand, and injuring the soft tissues. The heavy handles shown in the illustration will be found most suitable for use with these trimmers (Fig. 114).

Trimming the Roots of the Upper Anterior Teeth.—In working on the upper anterior roots, the instrument is grasped in exactly the same manner as a knife is held in sharpening a pencil, the only difference being that instead of resting on the ball of the thumb, the end of the thumb is placed against an adjoining tooth, as in Figs. 116 and 117, and the force exerted to strip the enamel from the root by a slight opening and closing movement of the hand.

The special scaler (Fig. 114) is of such shape that it closely follows the contour of the root. It is passed down below the gum line, crowding the gum away from the root until it goes beyond the enamel which is thus stripped off until the root is perfectly smooth.

Fig. 118.—Shows the trimming of the lingual portions of the left cuspid root, the thumb of the hand holding the instrument, resting on the thumb of the left hand.

In cases where the stump may stand by itself, and there is no adjoining tooth on which to secure a rest; especially if the gum be somewhat tender, the thumb or finger of the other hand may be placed on the gum with the end of the thumb of the hand holding the instrument resting against it (Figs. 118 and 119).

As we go farther back in the mouth, especially if the mouth be small and the cheeks tense, there will be times when it will be impossible to hold the instrument in the manner described. Then it may be necessary to grasp the instrument firmly in the right hand, and exert the force to strip the enamel with the thumb or finger of the left hand. The illustrations give a fair idea of the manner in which this is done (Figs. 120 to 125).

Fig. 119.—Shows trimming of the labial side of left cuspid, instrument and hands in same position as in Fig. 118.

Trimming the Roots of the Lower Anterior Teeth.—Trimming the roots of the lower anterior teeth is much more difficult than is the trimming of the roots of the upper and the different portions of the roots are far more difficult of access. It is impossible to hold the instruments in the manner in which they are held in trimming the upper roots. The same instruments are used, however, the operator standing at the back, and to the left of the patient, the chair being in its lowest position. The instrument is held in the right hand, and as nearly on a line with the long axis of the tooth as possible.

The fingers which are not used in holding the trimmers are braced against the teeth or some part of the upper jaw, so that there will be no possibility of the operator losing control of the instrument and injuring the tissues. The principal force is exerted with the thumb and finger of the left hand, that of the right being used only to steady and to give a pull to the instrument.

FIG. 120.—Shows trimming of right second bicuspid from buccal side, thumb of right hand resting on thumb of left hand.

In trimming the buccal or labial surfaces of the teeth on the right side of the mouth and around to the median line, the force used in stripping the enamel is exerted by the first finger of the left hand, the thumb being braced on the lingual side of the tooth or jaw and in such a manner that it will not be struck by the point of the instrument. The instrument is passed beneath the enamel and pressed tightly against the root, while the pull is being exerted with the right hand, as shown in Fig. 126. Nearly all of the mesial and distal sides of the teeth may also be reached by working the instrument in the same way.

FIG. 121.—Shows nearly same position, but part of the force for stripping the enamel exerted by thumb of left hand.

On trimming the lingual side of these teeth, the force is exerted by the thumb of the left hand and the fingers are braced on the buccal or labial side of the teeth (Fig. 127). In trimming the teeth on the left side of the mouth, these methods are reversed, the thumb being used to exert the force when working on the buccal or labial sides of the roots and the fingers when working on the lingual (Figs. 128 and 129).

On the mesial and distal sides, the force is applied the same as for the buccal and lingual, either the thumb or finger being used as is most convenient.

Where the operator is left-handed, the method of operating and the manner of holding the instrument would be reversed.

FIG. 122.—Shows trimming buccal corners of upper left molar, force exerted by first finger of left hand.

The enlarged special scaler (Fig. 114) is used on the labial or lingual sides of the root and if there is sufficient room between it and the other teeth it can be used on all sides; but if there are adjoining teeth so close as to prevent this, then the smaller scaler (Fig. 115) is used on the mesial and distal sides.

The scaler (Fig. 114) is the most universal, and can be used in almost every position where there is sufficient space between the teeth.

At times the enamel, principally of the cuspids and especially on the lingual side, is so heavy and so very firmly attached to the dentin that it is impossible to start it with these instruments, in such cases, the Case enamel cleavers may be used to start with, and afterward the finishing is done with No. 3 scales.

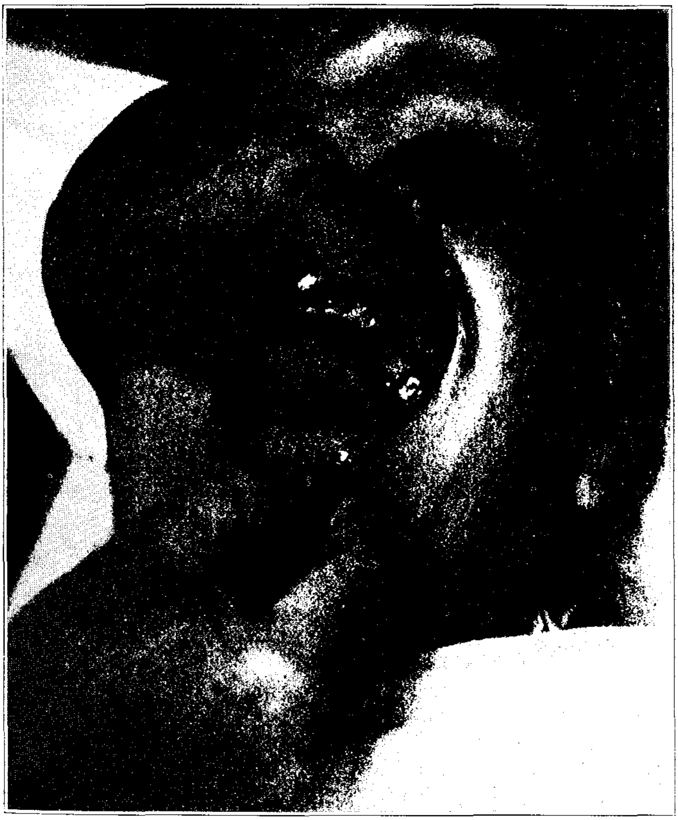


FIG. 123.—Shows trimming of lingual corners of upper left molar, force exerted by thumb of left hand.

The Case enamel cleavers (Fig. 130) have a strong sharp bit, and are very useful when a great deal of force is necessary. Their shape is such, however, that they do not leave the root smooth; the surface from which they have stripped the enamel is left in grooves and ridges, so that it is necessary to follow them with No. 3.

At times, even these instruments will not break the enamel, and it becomes necessary to start its removal with small carborundum points or diamond wheels, finishing with the No. 3 scaler.

FACING ROOTS FOR VARIOUS FORMS OF CROWNS.

It has already been said that the stump should be left standing for a considerable distance out of the gum, until after the root has been trimmed and the band fitted.

Richmond Crowns.—In the case of a Richmond crown, after the root has been trimmed, the band fitted, and the canal enlarged,

Fig. 124.—Shows trimming of buccal corners of upper right molar, force exerted by thumb of left hand.

the stump is cut away labially to from one-thirty-second to one-sixteenth of an inch below the gum margin, so that when the crown is completed the band will be entirely hidden. Lingually, if the bite will permit, it may be left standing from one-thirty-second to one-sixteenth of an inch out of the gum, so as to give additional support and strength to the crown, cutting the stump in a straight line from the lingual to the labial side (Fig. 111). This will apply to single crowns or those used as abutments for fixed bridges.

FIG. 125.—Shows trimming of lingual corners of upper right molar, force exerted by forefinger of left hand.

Porcelain or Downie Crowns.—For a porcelain crown a double slope is given to the root. The root is cut labially to the same depth below the gum as for a Richmond crown, but lingually it should be carried just to the gum border, leaving it high in the center.

The reason for this double bevel, instead of making it straight across from buccal to lingual, is that it is necessary to festoon the lower edge of the band to follow the gum line, and also to allow for a greater bulk of porcelain in order to give increased strength.

The septum of the process comes much higher up on the root mesially and distally than it does at the buccal and lingual sides of the teeth, and therefore it is necessary to festoon the band accordingly (Fig. 131).

FIG. 126.—Shows trimming buccal side of lower teeth, on the right side of the mouth, force exerted by finger of left hand.

If it were cut straight across, in order to place a perfectly flat floor on the band, the band would be cut entirely away mesially and distally, as shown in Fig. 132. As previously stated, the strength of porcelain is only in proportion to its bulk. For the purpose of illustration, we will exaggerate the figure somewhat, so as to make clear the reason for preparing the roots in the manner described.

We will suppose the case of an upper bicuspid crown where the bite is fairly close. It will be noticed that by giving a direct slope from the buccal to the lingual side, as would be done if it were a Richmond crown, that when the facing has been ground in place and the lingual side of the tooth built up with porcelain, it

FIG. 127.—Shows trimming lingual side of lower teeth on the right side of mouth, force exerted by thumb of left hand.

would render it very weak on that side, and would be quickly crushed, as there is so very little porcelain to give strength (Fig. 133).

If it were a Richmond crown where a gold back was to be used, then of course it would not make the slightest difference, as a small bulk of gold at this point would give far greater strength than would be possible if it were made of porcelain.

It will be seen that if the tooth is cut away to the gum line, so as to give it a double slope to the stump, that a much greater bulk of porcelain could be used with a corresponding increase in the strength of the crown (Fig. 134).

FIG. 128.—Shows trimming of buccal side of lower teeth on left side of the mouth, force exerted by thumb of left hand.

The facing of the roots may be done with a square-edged carborundum wheel, but this necessitates an unnecessary mutilation of the gum tissue. The best instruments for this purpose are the Ottolengui root facers (Fig. 135). These instruments are made in different sizes to correspond with the different teeth, and will do the work perfectly with but little or no mutilation of the soft tissue.

As these instruments come from the dental depots, the guide point is very much longer than it should be, unless the root is to be faced perfectly flat and at right angles with the canal. If, in order to slope the face of the root in either direction, the instrument

FIG. 129.—Shows trimming lingual side of lower teeth on left side of the mouth, force exerted by finger of left hand.

is inclined either labially or lingually, and unless the canal be very much enlarged the end of the point will strike the opposite wall of the canal so as to prevent the instrument facing the tooth on an angle, as will be seen in the illustration (Fig. 136). This point should be ground off so that its length is about the same as its diameter, and then there will be no trouble in sloping the face of the root in

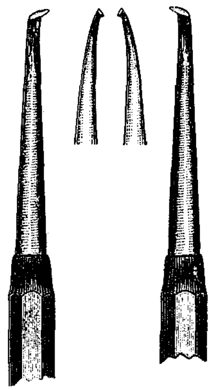


Fig. 130.—Enamel cleavers.

the desired direction (Figs. 137 and 138). If the root is much decayed and enlarged at the entrance to the canal, the length of the pin will make little difference.

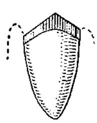


Fig. 131

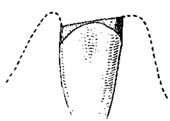


Fig. 132.

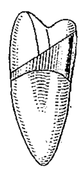


Fig. 133

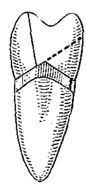


Fig. 134

In using these instruments, it will frequently be found that a facer, which is large enough to cover the root mesially and distally, will not reach the lingual and buccal sides.

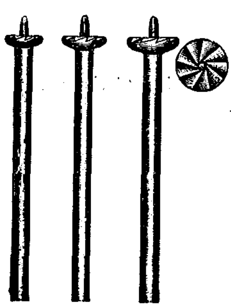


Fig. 135.—Root facers.

Fig. 136

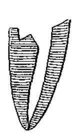


Fig. 137

Fig. 138

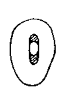


Fig. 139

After the floor has been united to the band and placed on the root, it may be that it does not go under the gum so as to be hidden. On removing the cap and examining the root, it will be seen that the facer has left a little ridge of dentin on the labial side which has prevented the band from going to place (Fig. 138). Where such is the case, by reaming the canal a little labially or lingually as shown by the illustration (Figs. 137 and 139), and enlarging the entrance to the canal to a slight depth, it will allow the facer to cover the root at both of these places.

CHAPTER VII.

IMPRESSIONS AND MODELS.

An impression for a working model on which a crown or bridge is to be made should always be taken in plaster. Modeling composition, wax or any of the plastic materials which are used for taking impressions should not be used for a working model, as there is no plastic impression material made which will give an accurate impression where there are undercuts or dovetailed spaces. The material will draw and drag, and become distorted on removing it from the mouth, with the result that the model made from such an impression will be imperfect.

IMPRESSION AND MODEL PLASTER.

A first class impression plaster should be fine and quick setting, thus rendering the impression soft and easily cut away from the model in separating.

A good model plaster, on the contrary, is coarse and slow setting, and becomes very hard.

The difference between a good impression plaster and a good model plaster can be instantly determined by rubbing it between the fingers. The impression plaster will be fine and smooth like flour between the fingers, while the model plaster will be coarse and the grit is plainly felt.

If so situated that it is difficult to secure the different grades of plaster, it is better to procure the hardest model plaster that it is possible to get. Then, by bolting this through a fine cloth a good impression plaster will be secured, in the finer material which passes through the cloth, and at the same time, by removing this fine plaster, the model plaster will be improved. It will be slower setting, and its hardness increased.

WEINSTEIN'S ARTIFICIAL STONE.

This new material (a calcium barium silicate) is eminently suitable for making models and articulations for bridgework, vulcanite work, and other purposes, where a stronger and more durable material than plaster of Paris is required. Models made from it are remarkably hard and durable and not friable, like plaster of Paris or any of the Portland cement preparations.

Another most valuable property of the artificial stone lies in the fact that it possesses practically no expansion or contraction. Upon periodic examination of a number of specimens under test for a year, no measurable change was found after the initial set had taken place. It contains no gritty or coarse particles and models made of it are very dense and smooth.

The following instructions for manipulating artificial stone are given by Mr. Weinstein:

Proportions for Mixing.—Accurate proportioning of the powder and the water that it is mixed with is imperative, and the results far more than repay the little effort that it takes to weigh out the powder and measure the water. For an upper or lower model, the following proportions are suitable: To $1\frac{1}{2}$ fluidounces of water add 78 to 80 dwts. (Troy) of the artificial stone powder.

The mixing is done in a rubber bowl, first incorporating approximately one-half of the powder, and gradually adding the balance, until all the powder is thoroughly incorporated. If the proportoins taken are correct, the mass will be as stiff as a very thick mix of plaster.

Preparation of Impressions.—The impression, if plaster, should be varnished with one coat of shellac, which should be allowed to dry for at least one-half hour, and then varnished with a coat of sandarac, which should be allowed to dry for at least one hour. The impression should then be immersed in water for at least five minutes, so that it may become thoroughly saturated. It is then removed and the excess water blown off with compressed air or wiped off with cotton, leaving the surface of the impression moist, but not wet. It is important that this be strictly observed, as a dry impression will absorb moisture from the artificial stone, while it is setting and produce a poor model. Modeling compound, or wax impressions require no special treatment.

Filling Impressions.—As the artificial stone is mixed quite thick, it cannot be poured like plaster, but must be brushed or packed carefully into all deep parts before filling in the bulk to build up a model. To facilitate the placing of the material into deep crevices or depressions, such as are found in an impression of a case with standing teeth, the following suggestion will prove helpful: prepare mix according to proportions given; take off about one-half teaspoonful, place it in the palm of the hand, or on a cement slab and incorporate with it some additional powder until it becomes as stiff as putty. Prepare from this small mix a number of small cones, lay them aside; work down some of the regular mix into the deep recesses, using a small brush or other means, then place a cone into each depression and tamp down with a small stick or the eraser end of a lead pencil. This will serve to force the plastic mix into all inaccessable places. The balance of the impression may then be filled in practically the same manner as in manipulating a thick mix of ordinary plaster. As this material sets quite slowly, ample time may be taken to fill the impression carefully.

Separating Impression.—The filled impression should be permitted to set at least four hours prior to separating; however, it should not be allowed to stand more than twelve or fifteen hours before separating as the hardness gradually increases, making it more difficult to do the required trimming.

The model will become as hard as well-set plaster of Paris within six or seven hours after pouring, and may then be used if necessary. The maximum hardness is attained within thirty-six to forty-eight hours.

IMPRESSION AND BITE.

In order to secure perfect results, the model on which the bridge is to be constructed must be as nearly perfect as it is possible to make it. The impression must be clear and sharp, so that the caps and bands, which have been in position in the mouth when the impression was taken, will fit accurately into place.

It is necessary that the articulation should be as perfect and accurate as is the model. These results can best be secured by taking what is known as a "squash bite," that is, taking the impression and bite simultaneously in plaster and by so doing far better results will be obtained than it is possible to secure in any other way.

In taking the impression and bite in this manner, the plaster is allowed to become quite hard and is then carefully broken away and afterward the broken parts are easily assembled, and the model secured from this will be a perfect reproduction of the required part of the mouth.

It is the general custom to take the impression for this work in the ordinary manner, using a tray for the purpose. A separate bite is afterward taken in wax or modeling composition and the model prepared from this. It is not possible to secure anything like the accuracy, in taking the impression and bite in this manner, as it is by taking the squash bite in plaster.

The model is first cast, and after it has become hard and has been separated the waxed bite is pressed into place. It generally happens that this bite has to be trimmed more or less in different places before it can be pressed into position. The wax being hard, considerable pressure is necessary and it is liable to be forced farther down on the model in one place than in another, with the result that the articulation is not exactly as it should be. Then, after the bridge is completed, it is necessary to do more or less articulating when it is adjusted in the mouth. This necessitates taking the piece to the laboratory for refinishing.

Where a plaster impression and articulation has been taken in the manner described, it is possible to construct a bridge and finish it so that when it is placed in the mouth the occlusion will be so nearly perfect it will rarely be necessary to do any grinding at all.

COLORING AND FLAVORING IMPRESSION PLASTERS.

It is an excellent idea to tint the impression plaster slightly, as this difference in color from the model will very materially aid in separating the impression from the model. Another good plan is to flavor the plaster slightly. It has been the custom of the writer for many years to tint the impression with carmine, and also to use a few drops of cologne in the water in which the plaster is mixed. This cologne not only imparts an agreeable flavor to the plaster, but in many instances it will entirely overcome the nausea to which some patients are subject when plaster is placed in the mouth. It has been found that in many instances, where it has been impossible to get a plain plaster impression without the patient becoming nauseated, that these few drops of cologne water will entirely prevent it.

The method of preparing the carmine and cologne solution is as follows: A half ounce bottle is filled about one-quarter full with carmine, and the bottle then filled up with strong ammonia, this being the only agent available that will thoroughly dissolve it. This solution is well shaken until the carmine is all dissolved. The bottle is then left unstoppered for a day or two, until the fumes of ammonia have passed off.

About one-fifth to one-quarter of this carmine solution is put in a six ounce bottle and the bottle filled with cologne and this gives us the coloring and flavoring solution. A few drops of the solution is added to the water in which the plaster is to be mixed, thus giving it the color and flavor desired. The cologne used should be an alkaline solution, as should it be acid it would precipitate the carmine.

The setting of the plaster may be hastened in many ways, and it is generally desirable that this be done in taking impressions. It may be accomplished by mixing the plaster with warm water or by adding to the water a little common salt, or potassium sulphate. Much stirring also will have the same result. The proportions of water and plaster used will also accelerate or retard the setting. The writer prefers the potassium sulphate for this purpose, as very little will accomplish the purpose, and it does not impart a disagreeable taste to the mixture as is the case where the salt is used.

The amount used depends on the size of the impression which is to be taken. If this be small, we can use proportionately more than we could for a large impression, as a longer time is required to spread the plaster in the mouth for a large impression than it does for a small one. In the case of a full impression, very little should be used, and at times none at all. The amount used, however, will depend upon the particular batch of plaster with which we are working, as there is hardly any two lots of plaster which will work exactly alike, some setting much more quickly than do others. In getting a new supply of plaster, it is always best to make one or two mixes, before using it in the mouth, in order to become familiar with its properties.

To get the best results for impressions, the plaster should also be thoroughly mixed. The method of mixing is as follows: First place a little of the potassium sulphate in the bowl, adding a few drops of the carmine and cologne solution, and then as much water as is needed for the impression under consideration. The plaster should never be thrown in the bowl carelessly and in large quantities, but should be sifted into the water carefully and in small quantities, taking it on the spatula and sifting it round the edges of the bowl. The plaster will work toward and settle in the center so that there will be no air confined in a mass of dry plaster.

The plaster should be added slowly until it comes just about to the surface of the water, but not enough is used to take up all the moisture. This is then carried to the chair without stirring. By refraining from stirring the mix, the plaster does not begin to set and it will give some little time in order to examine the mouth and see that everything is all right, the caps in position, etc. After it has been ascertained that everything is as it should be, begin mixing the plaster, stirring it with the flat of the spatula and cutting through the mass with the spatula held edgewise to work out the air bubbles. The stirring should be kept up until the plaster is just stiff enough so that it will not drop from the blade of the spatula when it is inverted. It is then ready for use in the mouth.

TAKING THE IMPRESSION WITH ABUTMENTS IN PLACE.

First cover well with the plaster the bands or caps on the abutments, and then fill in the spaces between the abutments, and also taking in several of the adjoining teeth. The occlusal surfaces of the occluding teeth are also covered with the plaster.

The patient is then instructed to close the mouth tightly and the teeth which have not been included in the impression are carefully examined to see if the proper closure has been obtained.

Securing the Proper Closure.—At times it is very difficult to get the patient to close the mouth properly on a mass of plaster or wax. There are many different ways of inducing the patient to give the proper bite, such as having the patient swallow, throwing the head far back while closing the mouth, and at times even using force to throw the chin back where it belongs.

The writer has frequently found that where every other method would fail, a proper occlusion could be secured if the patient would turn the tip of the tongue as far back on the soft palate as possible and hold it there while bringing the jaws together. It will be found that it is impossible for a patient to give a wrong closure if the tongue is held in this position until the jaws are closed, as the chin cannot be thrust forward or from side to side without moving the tongue.

The impression should be left in the mouth until the plaster has become thoroughly hard and brittle. This is ascertained by testing from time to time the plaster remaining in the bowl. As soon as it breaks with a clean, sharp fracture, and when a small particle rubbed between the thumb and finger cannot be crushed, the impression will be sufficiently hard to be removed from the mouth, but as long as the plaster can be crushed between the thumb and finger and moisture squeezed from it, it should not be removed.

When it has thoroughly hardened, the patient is instructed to open the mouth, and the impression is carefully removed, every broken particle being saved. It is very rarely that an impression taken in this manner will come away whole, but will be more or less broken up, sometimes in many pieces. It is well to have a little tray with the bottom covered with a piece of blotting paper, on which to lay the impression. The broken parts, as they come from the mouth, should be so placed on the tray that it can be remembered where they belong. This will render much easier the task of putting together the broken impression.

The caps and bands are then removed from the abutments. If any of the abutments are in the anterior part of the mouth where bands are supposed to be hidden, the stumps should be protected. This can generally be done by simply taking a piece of base plate gutta-percha and rolling it something in the shape shown in Fig. 140. The root is then thoroughly dried, the gutta-percha slightly heated and the small end introduced into the canal. The bulbous portion is then pressed over the face of the root carrying it well over the edge and forcing the soft tissues away. This will prevent the gum from growing over the face of the root, and will render the subsequent placing of the band or cap much easier than it would otherwise be.

FIG. 140

At times a large-headed tack may be used for this purpose. The point of the tack can be shortened, so as to allow the head to come flush with the gum line. The shank is covered with base plate gutta-percha, and it is then warmed and forced into the root and the surplus gutta-percha carried over the head of the tack, so that the metal will be covered (Fig. 141).

Treatment of Impression.—After the impression has been removed from the mouth, it should be left on the blotting paper for from fifteen to twenty minutes, so as to allow the excess moisture to be absorbed, but not long enough to dry the plaster, as the impression can be put together more easily and quickly, and also more accurately, if the impression is a little moist. The parts are then carefully assembled and fastened together with a strong wax. The wax for this purpose should be sticky, tough and sufficiently hard that it will not bend in the handling.

FIG. 141

The writer has found that the following formula will make the best wax for this purpose:

Pure white beeswax	16 ounces.
Pure white resin (powdered)	3 ounces.
Gum Damar (powdered)	3 ounces.

It should be melted in the order given, and well stirred until the powdered resin and gum damar are thoroughly incorporated with the wax. It can be poured in cups or moulds, or rolled into sticks of any desirable size or length.

The ordinary dark beeswax and dark resin, may be used in making the wax, but it does not make a hard wax that is as clean and nice to work as does the white. We must be certain, however, that the beeswax is perfectly pure. If there should be the slightest trace of paraffin in it, the wax made from it will be worthless.

After the impression has been put together, the caps and bands are put back in it in their original positions, care being taken to see that they fit exactly into place. They are then waxed firmly in the impression with sticky wax. In the case of an anterior abutment where we have a cap and tube, the cap is held in position firmly with the instrument, and the edges of the band are waxed tightly labially and lingually (Fig. 142, points *a* and *b*) before waxing it on the sides, thus holding the caps immovable while the sides are being waxed. If we attach it in one place only at first, say on the lingual side of the cap, the contraction of the wax on cooling is liable to draw the cap away from the impression labially, thus giving to it a false position, so that, after the model is made and the bridge completed, it will be found that it will not go in the mouth as it should.

The edges of the caps standing out of the impression are waxed heavily on the outside with hard, sticky wax (Fig. 143). This will not only hold the band in place, but will also help to hold the impression together. The inner side of the cap is covered with a very thin film of pink paraffin wax. In the case of a cap for a

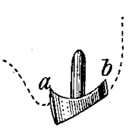


FIG. 142


FIG. 143

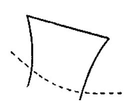


FIG. 144

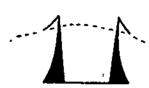


FIG. 145

shell crown, or where the band is larger at the occlusal end (Fig. 144), enough wax should be put on the inside of the band to obliterate any undercuts or dovetailed spaces (Fig. 145). If there are pins or tubes in the caps they should also be covered lightly with the paraffin and wax.

The gingival edge of the band should be scraped clear of wax, so that it will set down tightly to the model. The object in having the outer edges of the band covered thickly with wax we will now explain.

If we put but a thin film of wax around the outer edge, as we do on the inside of the band, it will be noticed that after the model has been made and the band removed, that there is a fine groove in which the gingival end of the band rests (Fig. 146). The result will be that after taking off and putting on the cap a few times, some of the plaster may be scraped from around the sides of the stump which, working into the groove, will fill it partially, with

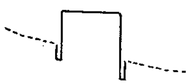


FIG. 146

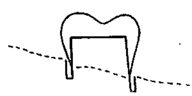


FIG. 147

FIG. 148

the result that by the time the crown is completed, the band may not go nearly as far beneath the gum as it was originally intended that it should (Fig. 147); whereas, if it is waxed heavily on the outside, when the band has been removed, the wax is stripped away, leaving a wide groove on the model around the stump, so that if any plaster is scraped from the model and gets into the groove, it is quickly noticed and easily removed (Fig. 148).

Separating Medium.—Different materials are used for this purpose such as soap, oil, shellac, or sandarac varnish, or shellac and sandarac varnish combined. Oil is a very good separating medium but the surface of a model cast in an oiled impression is never as hard as it should be, and it is also more liable to be porous. The same may be said of soap, as a separating medium. It makes separating the impression from the model very easy, and will give a clear-cut, sharp-outlined model, but as in the case of the oiled impression, the surface of the model will not be very hard. If soap is used, after using, the impression should be thoroughly washed with clear water, otherwise there will be bubbles and a porous surface which will render the model unfit for use.

Shellac is used by many to first color the impression, which is then given a coating of sandarac varnish. The use of both of these varnishes is unnecessary, as, if the sandarac varnish is slightly colored, it will accomplish the object. The varnish can be colored with various dyes, but a very simple way is to scrape a little of the crayon of an indelible pencil into the varnish, this on dissolving will impart to it a purple color.

The impression, which is varnished until it has a glazed surface, will give a model with a much smoother and harder surface than it is possible to secure by using soap or oil. However, the varnish should not be so thick as to obliterate the fine lines which we wish to preserve in the model.

The impression should be moist in order to take the varnish and leave a glazed surface. If it is placed on a blotting pad and left for fifteen or twenty minutes after the impression has been removed from the mouth, it is generally in the right condition to take the varnish best. If the model is too dry, the varnish will soak in and not give a glossy surface. If the impression stands for some hours after taking before assembling and varnishing, it will have become too dry, and should be dipped in water and then placed on a blotter for a few minutes, before varnishing. If the model is too wet the varnish will not stick, but will roll up and scale off.

As soon as the varnish has hardened, which will be in four or five minutes, the impression can be dusted with talcum powder, which is afterward blown out with a chip blower. This will render the separation of the impression and model very much easier.

TAKING IMPRESSIONS IN SECTIONS.

At times it is desirable to secure an impression where the teeth are very much loosened, and where it would be impossible to obtain an impression in an ordinary tray, with any material, without risk of removing the teeth with the impression, and also causing the patient considerable pain.

There are times when some of the lower incisors may be so loose that it would be possible to remove them easily with the thumb and finger, yet it is desirable to retain them in position for a time, with some kind of a splint. By taking the impression for a case of this kind in sections, it can be done without the pain to the patient, nor the slightest danger of removing the teeth.

The plaster is prepared and mixed the same as described for taking an impression and bite simultaneously. The teeth are pressed into their proper position and held so with one of the fingers of the left hand (Fig. 149). With the aid of a spatula the plaster is placed on the lingual side of the teeth and smoothed off, letting it extend a little above the incisal edge.

After the plaster has hardened, the finger is removed from the labial side, the plaster holding the teeth firmly in place. The plaster is then trimmed flush with the incisal edges, beveled on the lingual side and then slight grooves are made in one or two places to serve as guides in putting the sections together (Fig. 150). This is now covered with a separating medium and for this purpose a soap solution is most convenient.

FIG. 149

A fresh mix of plaster is then made, and the labial side of the teeth is covered heavily, the plaster being carried over the incisal edges, and over the beveled portion of the plaster impression on the lingual side (Fig. 151). It is then left until it has become quite hard. The labial side of the impression is then pried away, forcing it outward and upward, after which the lingual side is carefully removed.

These two halves are then put together and waxed, and we have as perfect an impression as it is possible to secure (Fig. 152), giving the interspaces between the teeth, which cannot be gotten by any of the ordinary methods of impression taking. When the model has been made from this impression, it gives an exact reproduction of the teeth in their normal position, from which a splint or retaining bands can be made.

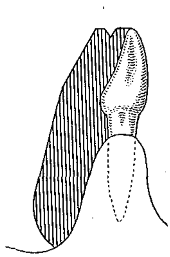


Fig. 150

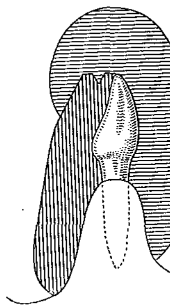


Fig. 151

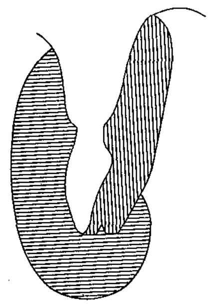


Fig. 152

This method of impression taking may also be employed to advantage in any case where there are dovetail spaces or deep undercuts. It is also valuable in securing accurate models for orthodontic or other purposes, or in the reproduction of models. When it is desirable to get a very accurate impression of a lower jaw, where the teeth are inclined very much lingually, or where there are dovetail interspaces from which teeth have been lost, by this method impressions of the greatest accuracy are easily obtained.

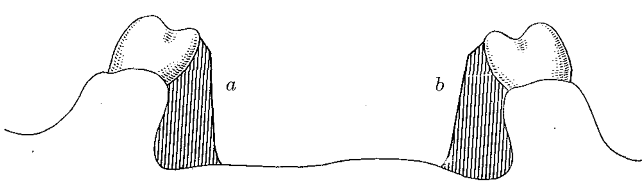


Fig. 153

In securing a full impression, the lingual sides of the teeth are first covered, the plaster being carried well down over the gum, and then smoothed so that the sides will slope away from the sides of the teeth the same as a core on an undercut model in getting a mould for casting a die (Fig. 153, *a* and *b*). The upper side is trimmed, preferably, about one-thirty-second of an inch below the occlusal surfaces of the teeth. The plaster is then given a coating of the soap solution, and an impression taken over this, using an ordinary tray, carrying it well down over the plaster which has been placed on the lingual sides of the teeth (Fig. 154).

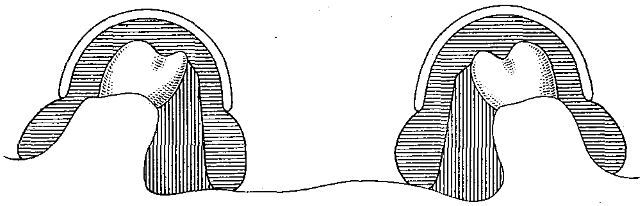


FIG. 154

After the impression has hardened, the tray is removed together with the impression, leaving the plaster cores first placed on the lingual sides of the teeth, still in the mouth (Fig. 153, *a* and *b*). These pieces are then pried away and placed back in the impression in the tray (Fig. 155).

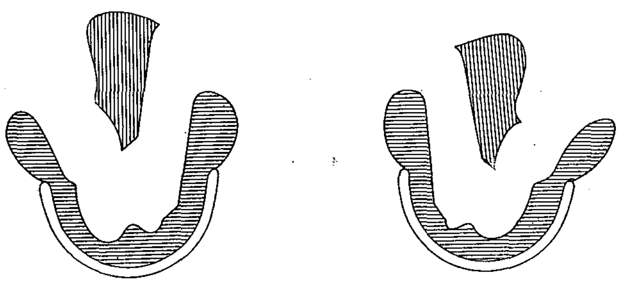


FIG. 155

A full and perfect impression of the mouth has thus been secured from which a much more accurate model can be made than it is possible to obtain from an impression taken in the ordinary manner.

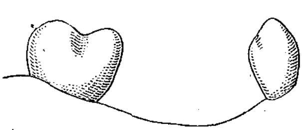


FIG. 156

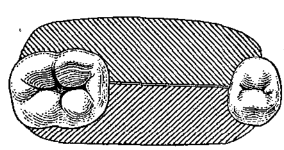


FIG. 157

This method will also be found very useful where an exact reproduction of a plaster model is desired.

An impression of dovetailed interspaces, from which teeth have been lost (Fig. 156), can easily be obtained by putting plaster first on the lingual side of the teeth, and letting it come to about half way through the space to the buccal side. This is smoothed off, covered with a separating medium, and filled in from the buccal side (Fig. 157), and an impression taken over that in a tray in the manner already shown in Fig. 154.

ARTICULATORS.

In crown and bridge-work, the question of occlusion is of most vital importance, as the stability and life of the work depends to a very great extent upon its proper occlusion with the opposing teeth.

In all extensive cases of bridge-work, it is absolutely essential that only first-class anatomical articulators, capable of reproducing the natural, lateral or triturating movements of the mandible, so necessary for perfect mastication, should be used. For single crowns, and at times for small bridges, it is permissible to use some other type.

Nearly all of the small, so-called crown articulators on the market are absolutely worthless so far as securing good results are concerned. With these articulators, the only movement possible is simply the up and down, or opening and closing movement of the mandible. Of late, a few small articulators have been placed on the market which are capable of imitating the various movements of the lower jaw.

A plaster articulator, if it is properly made, will give excellent results for single crowns and also for small bridges, and the manner of making such articulations will be described further on.

In making an entire denture, the matter of occlusion is of especial importance, and the difficulty of securing an accurate occlusion is far greater than where only a portion of the teeth are to be restored. If a full bridge is to be made for the upper jaw, and the majority of the teeth in the lower jaw are in place, the attachments for the molars can be made and if properly articulated will then serve as a guide in getting the bite, or the occlusal surfaces of these teeth may be built up with cement so as to interlock with the lower teeth, and open the bite to the proper distance.

In the majority of these cases, the impression and bite should be taken in plaster, the same as in smaller cases, and the face-bow should be used to serve as a guide to mount the models properly on the articulator. The semicircular plate, to which the stem of the face-bow is attached, is pressed in the soft plaster as soon as the patient has closed the mouth and the upper surface of the disk partially freed from the plaster, as it is necessary to remove it to permit of the plaster impression being nearly all cut away before the model is mounted on the articulator.

The face-bow is used in exactly the same manner as in taking a wax bite for a plate. The index rods are adjusted to the external ends of the condyles and the stem of the plate, which is imbedded in the plaster, is fastened in the clamping device and the whole retained in place until the plaster has thoroughly hardened, when the impression with the bow attached is removed from the mouth.

It will be remembered that after imbedding the disk in the impression, the plaster has been scraped partially away from the upper surface for the purpose of weakening it so that the disk can easily be removed. This is done by holding the impression in one hand and grasping the stem in the other and lifting it until it breaks away, care being used not to disarrange the adjustment of the stem in the bow.

The caps and bands are now removed from the mouth and carefully placed in the impression and waxed in place, in the manner already described, and the impression varnished. After varnishing it is well dusted with talcum powder and the surplus powder is blown out with the chip-blower so as to render the separating easier.

The lower half of the model is cast first and the surplus plaster placed on a slab. The model is then placed on the plaster and leveled very carefully. After this has hardened, the upper side is cast and this is also inverted and placed on the surplus plaster on the slab, leveling it so that this side is parallel with the lower half. In casting both the upper and the lower, care must be used not to get any plaster at the point where the plate, from the face-bow, has been broken away.

After the model has thoroughly hardened, the bulk of the impression is carefully cut away, simply leaving a few points of contact to hold the halves in position and also preserving the surfaces where the semicircular plate has been attached. The plate is then carefully fitted in its proper position and waxed firmly in place. The bow is attached to the articulator and the models are fastened and built up properly with plaster. The face-bow is now removed from the articulator and the remainder of the impression is cut away, thus releasing the halves and giving a perfectly occluding working model.

In making a full denture, it is more necessary, than in small cases, that the articulator which is used should be one which will give all the natural movements of the mandible. The Gritman or Snow articulator is recommended, being simple and easy of manipulation (Fig. 158).

If the face-bow has not been used, the model is prepared in the same way, casting the lower half first and leveling it very carefully on the surplus plaster on the slab, so that the occlusal plane will be as nearly correct as it is possible to make it. The upper half is then cast in the same manner and made so that the upper and lower surfaces are perfectly parallel.

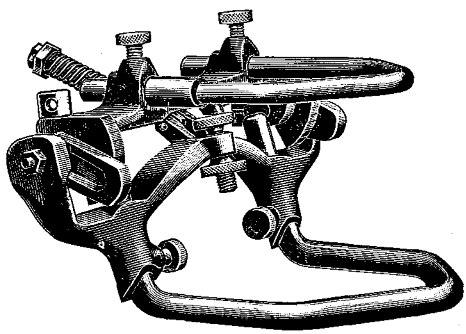


FIG. 158

After the model has thoroughly hardened, the impression is cut away, leaving only three or four points of contact to retain the parts in their normal position. In such cases, the anterior part should be well exposed, and also the buccal sides of the molars on each side of the model, so that the position of the median line can be determined. The exposed parts will serve as a guide in mounting it on the articulator, after which the remaining parts of the impression can be cut away.

Making a Plaster Articulation.—It is always best to follow some fixed rule in making small models from a "squash" plaster impression and bite. In fact, to follow some fixed rule of procedure in all of our operations will be time-saving. The lower half of the model is always cast first, irrespective of which jaw the bridge is being made for. The object of this is as follows:

A very large proportion of bridges made are those which restore teeth which have been lost from either side of the mouth, extending from the bicuspids to the molars. The models for these cases will often be made on nearly a straight line, their shape giving no clue as to which side of the mouth they belong. After the two halves have been cast, the next step, after removing it from the slab, will be to cut away the surplus plaster, and do a portion of the trimming before separating. If the rule of casting the lower half of the model first has been followed, as soon as the distal portion of the model has been trimmed

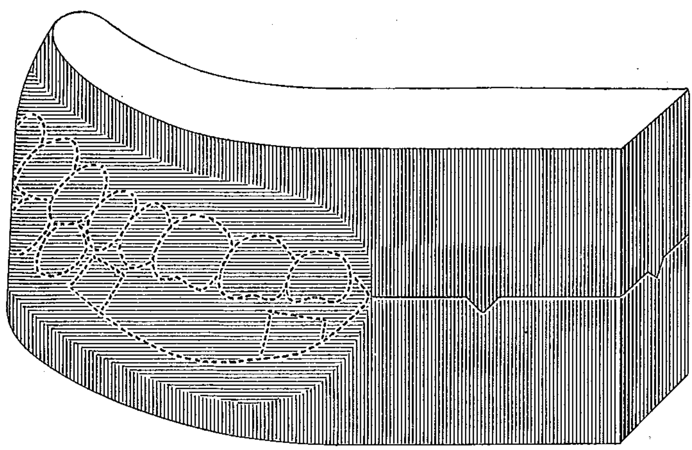


FIG. 159

sufficiently to show upon which half the grooves were cut, it can be told at a glance which is the upper and which is the lower half. (Fig. 159). This enables the operator to tell very nearly where the abutments are located, and knowing this, the impression can be cut away more quickly and certainly than if the models were made in a haphazard way. In the latter case, the operator would have to work much more slowly, carefully cutting into the impression until a part of the model was exposed, before determining which was the upper and which was the lower, thus losing many minutes of valuable time.

CASTING OF PLASTER MODELS.

The models should always be well made and neatly prepared, and should also be of a size corresponding to that of the work which is to be done upon them.

A piece of work should never be undertaken on an irregular and ungainly mass of plaster, called a model. The models should be carved and finished neatly. It is an old saying that a good workman can do good work with poor tools and instruments, but there is no question but that he could do much better work if he had better tools and instruments with which to do it with, and so can a man do much better work on a model which is well and neatly prepared than it is possible to do on one which is poorly made.

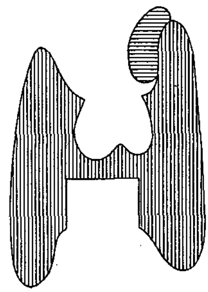


FIG. 160

As previously stated, the model plaster should set very hard and is coarser than the impression plaster. The difference between the two can be readily distinguished by simply rubbing it between the fingers, the impression plaster being fine and smooth like flour, while the model plaster will feel coarse and rough in comparison. In mixing the plaster, cold water is used and nothing should be added to hasten the setting as this will tend to make a softer model. It should be stirred very lightly, as much stirring has a tendency to hasten the setting of the plaster, thus making it softer. The water is first put in the bowl and then the plaster carefully sifted from the knife or spatula around the edges of the bowl, allowing it to work toward the center. The

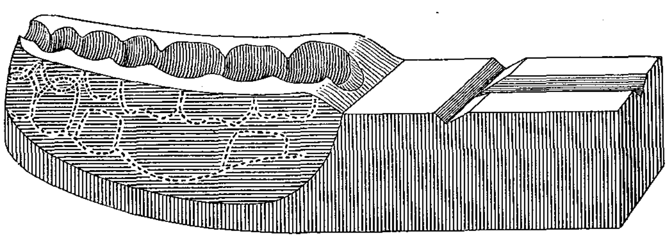


FIG. 161

plaster is slowly added until all the moisture is taken up so that it will be a fairly stiff mass. The plaster should never be so soft that it can be poured into the impressions. It is well to remember that the stiffer the plaster is mixed, the harder will be the model. It should be stirred just enough to thoroughly incorporate the plaster and follow this by cutting through the mass, with the spatula edgewise, to work out any air bubbles which may be there.

The impression previously coated with separating solution and dusted with talcum powder, is dipped in water and the water lightly shaken out, leaving very little in the deeper parts. A small portion of the plaster is then placed on the sides of the impression and worked down into the deeper parts by jarring it with the hand (Fig. 160), adding a little at a time, and working it down gradually, so that no air bubbles are enclosed in the mass. This is continued until the impression is filled. The excess of plaster is then placed on a glass slab and the impression inverted and pressed into it. The excess plaster should extend about one and one-half inches back of the impression (Fig. 161). This can then be smoothed off and grooves cut into it to the depth of a little less than one-eighth of an inch, say about three thirty-seconds, one groove being cut at right angles to the mass, and the other parallel with the sides and in the center of the extension (Fig. 161).

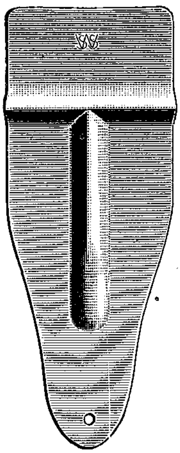


Fig. 162

A simpler and quicker method is to use the little articulating plates designed by the writer, and which can be purchased at any of the dental depots (Fig. 162). They were carefully designed and much study was given to the depth of the grooves which they would make in the plaster. The grooves are made so that with the lateral movement, the model

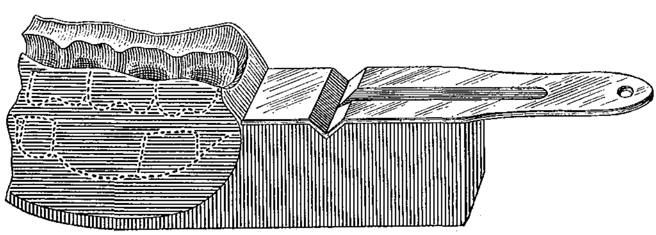


Fig. 163

will be raised and lowered to about the same degree as the cusps would give to the same movement in the mouth. If the grooves are made too deep, in moving the model in any direction, the articulator would be opened too wide, and if they are too shallow the movement would not be sufficient.

These articulating plates are used as follows: The excess of plaster is extended backward from the impression about one and one-half inches. The lower side of the plate is moistened and covered with soft plaster and is then pressed into the surplus extending back of the impression, so as to come even with the occlusal surfaces of the teeth (Fig. 163). The excess of plaster is trimmed away from the impression and flush with the edges of the plate and the model left until the plate will come away by simply touching it lightly on the under side of the extending handle. This will

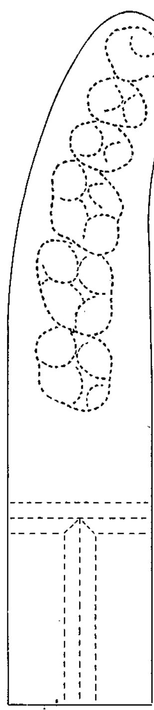


Fig. 164

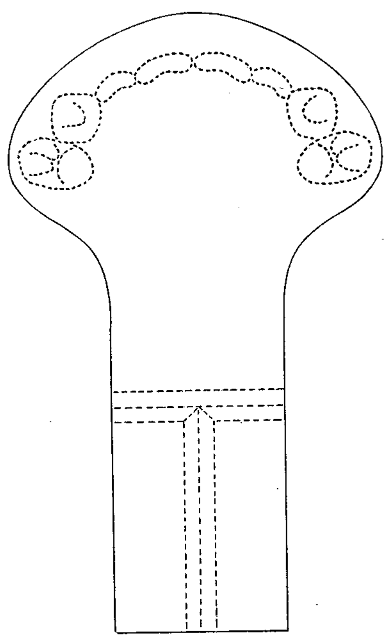


Fig. 165

generally be in from five to eight minutes after the model has been cast. It is not well to undertake to remove the plate forcibly before the plaster has hardened, as if this is done the plaster will adhere to it and will roughen the articulating surface.

After the plate has been removed, the grooves will be in the right position and of proper depth. The model is loosened from the slab by holding the slab over the Bunsen flame for an instant. The model is trimmed, the sides smoothed and the articulating surface varnished with the colored sandarac.

The second or upper half is now cast in exactly the same way, wetting it and then jarring the plaster in, a little at a time, until the impression is filled and the plaster carried back to about the same depth over the articulating surface.

The excess plaster is then put on the slab as before and the piece inverted and pressed into it, keeping both sides parallel. After it has become sufficiently hard to remove it from the slab, it can be trimmed and smoothed, preparatory to separating.

In making the articulation, the model should be made to articulate so that the movements will be exactly the same as in the mouth. If the crown or bridge is on the side of the mouth, the articulation should be carried directly back from the molars following the line of the arch (Fig. 164). If it is in the anterior part of the mouth, it should be directly back of and in line with the median line and the center of the palate (Fig. 165).

SEPARATING THE IMPRESSION FROM THE MODEL.

When the plaster for the impression has been tinted, the impression and model are easily distinguished by the difference in coloring. It can readily be seen, from having run the lower half first, on which half of the model the bridge is to be made, and knowing that the occlusal surfaces of teeth are on a line with the articulating surfaces of the model, it is possible to determine very nearly where the abutments are located. The impression is rapidly cut away over these abutments until they are exposed, and they will serve as a guide for removing the remainder of the impression. This should be done very carefully and after it has been removed, the separation of the balance can very easily be completed by working them slightly from side to side or introducing the point of the knife between the forward end of the articulating surface and rotating it a little. The model is then trimmed and carved as may be desired.

Preparing Working Models.—In making a bridge for the back of the mouth, where the abutments are to be shell or telescope crowns, if the teeth are properly prepared, the entire work of making the bands and completing the bridge can be done on the model. There will be no necessity for seeing the patient after we have taken the impression and bite, and we can be sure that the bridge, when completed, will go in place as it should.

When the work is to be done entirely on the model, the teeth must be carefully and accurately trimmed, and not only should the abutments be parallel, but there must be no ledges below the gum line which will interfere with the placing of the bands in position.

Extreme accuracy in the preparation of the abutments, so that the sides will be only slightly larger beneath the gum line and practically free from ledges, will come only with practice, and by using great care in the work. The knowledge that if this perfect preparation is accomplished, all of the work can be performed out of the mouth, will serve as an incentive for the operator to put forth his best efforts.

It is always advisable to do as much of the work as possible on the model and only such as may be necessary in the mouth, as the moral effect on the patient is something to be desired. It does not make any difference how skillful the operator may be, his best efforts will, at times, seem clumsy to the patient. They do not always realize the care and accuracy which is absolutely essential in fitting the band. The constant taking off, trimming and replacing the bands on the teeth is necessarily painful, and may often suggest to them that if the operator was as skillful as they had supposed, he should be able to do the work more quickly, and with less pain. On the other hand, if, after the impression has been taken, they are not required to call again until after the bridge is completed, it will seem to them marvelous that such beautiful work could be produced from an impression that appeared to them to be but a few worthless bits of broken plaster, and they will immediately be inspired with a much higher opinion of the skill and abilities of their dentist.

After the models have been separated and carved, they should be thoroughly dried with a gentle heat. If they are dried rapidly, the plaster will become baked, with the result that it will be soft and chalky, easily crumbled between the fingers, and worthless as a model. In cold weather, by placing the models in front of a register or over a radiator, the proper amount of heat to dry them slowly and render the models hard will be obtained.

FIG. 166.—Hoes.

After the models are thoroughly dried out, they should be carefully trimmed. This is best done with a fairly broad hoe-shaped excavator (Fig. 166), with the edges of the inner sides of the instrument slightly rounded so that it will not scrape the sides of the abutments. The plaster is carefully cut away to about one-sixteenth of an inch beneath the gum line, using great care to cut to the same depth all around, and also, not to scrape the sides of the stumps so as to change their size and shape, otherwise bands which are fitted to the model will not fit the teeth in the mouth (Fig. 167).

After the stumps have been carefully trimmed, the models should be thoroughly saturated with dilute sandarac varnish. This can be done by using a brush and painting them repeatedly with the solution, giving them one coating after another as long as the varnish will soak into the plaster, or until it begins to glaze. If the models are not too large, they may be placed in a large jar of the varnish and left in it until they have taken up all that they will. The varnish should be thin so that it will soak well into the plaster. The sandarac varnish as procured at the dental depots, diluted from one-half to three-quarters with alcohol, will be of about the right consistency.

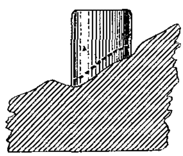


Fig. 167

The models are now again dried out thoroughly with a gentle heat, and it will be found that the surfaces are extremely hard. By using care, a number of pieces might be made on the same model, with but little or no abrasion of the stumps.

There are other ways of hardening models. A favorite one is, after they have been carefully prepared and thoroughly dried, to boil them in sterine or paraffin. This makes a beautiful model, but one not as good to work on as those which have been treated with sandarac varnish. The varnish makes them much harder and gives them a better wearing surface.

CHAPTER VIII.

BUILDING UP BROKEN-DOWN ROOTS WITH AMALGAM PREPARATORY TO CROWNING.

THE building up of roots with amalgam, preparatory to crowning, is a very questionable proceeding. Every dentist knows, or should know, that gold and mercury have a great affinity for each other. It is this known affinity of the metals which is taken advantage of in the treatment of gold by the amalgamation process. If the mercury could be entirely removed from the amalgam of course there would be no objection to its use, but this cannot be done and if it could, it would no longer be an amalgam.

The gold crown, coming in contact with the amalgam, is attacked by the mercury and disintegrated. Many times, even where gold bands come in contact with old amalgam fillings which have been

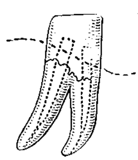


FIG. 168

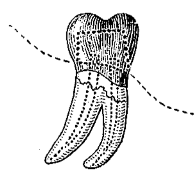


FIG. 169

in the mouth for years, the effect will be the same. The writer has seen many instances of this kind, where a tooth having amalgam filling has been covered with a gold crown, the band coming in contact with the filling, with the result that within a year or two the entire side of the crown has been disintegrated and broken away. Of course, if the band be made of crown metal, or of platinum, the effect would not be so marked, but the platinum caps, in connection with the bridge, are undesirable and unsightly.

Another objection to this method, ignoring entirely the remarkable affinity which gold and mercury have for each other, is that from a practical standpoint, in the majority of cases, in a root so built up with amalgam, the amalgam stump is in reality an element of weakness rather than of strength.

We will take, for example, a molar which is broken or decayed well below the gum line. The general practice, in building up these roots, is to put pins in the canals and then build the stump above the gum, trimming the amalgam flush with the sides of the stump (Fig. 168). The band is fitted to the amalgam stump, the crown made and the bridge connected to it (Fig. 169).

In masticating, the lateral strain on this stump is very great and the tendency is for the amalgam to pull away from the face of the root labially and lingually, allowing moisture to work in, with the result that the tooth or stump will decay, eventually resulting in its entire destruction. We say that there is a tendency for this to happen, but there is more than a tendency . There is an absolute certainty that this will occur sooner or later. There is also a liability of the root becoming fractured from the extra strain which is thus placed upon it.

CROWNING BROKEN-DOWN ROOTS.

When a tooth is broken or decayed below the gum line, the band should always be carried below the line of fracture or decay in order that the root may be perfectly protected.

In a majority of cases of this kind, it is practically impossible to fit the band in the mouth or indeed, even to get a correct measurement of the root. Even if it were possible to do so, it could be done only at the expense of excruciating pain to the patient. In all cases of this class, the band should be made and fitted to a carefully prepared model.

Taking Impression and Preparing Models for Broken-down Teeth or Roots.—We will consider first a very common example of this class. An upper first or second bicuspid. The roots of these teeth are often found decayed far below the gum line. Sometimes, on the mesial and distal sides, below the process, while on the buccal and lingual sides they may be decayed beneath the gum, but not to the same depth as mesially and distally (Fig. 170). It can be readily seen that a root in this condition, cannot be treated in the same manner as one which is standing out of the gum, and the only method which can possibly be followed with accuracy and a minimum amount of pain to the patient is to first secure an accurate impression of the face of the root and then prepare a model on which to fit the band.

Usually the gum tissue has grown over the stump. This must first be removed, either by cutting it away with gum scissors or a lancet, or by using trichloracetic acid or some other powerful escharotic. After this has been done, it is better, in order to still further free the root-end from the gum tissue, to pack it tightly with gutta-percha or cotton, and let it remain for a day or two, so that when the work is commenced, the face of the root may be perfectly free from all intruding tissue.

It is rarely that there is much trimming to be done on such roots, as the decay has generally passed beyond the line of enamel to a point where the sides of the root are nearly parallel. The little trimming may be necessary should be carefully done, and with very sharp instruments.

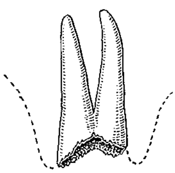


FIG. 170

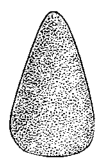


FIG. 171

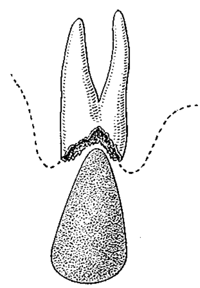


FIG. 172

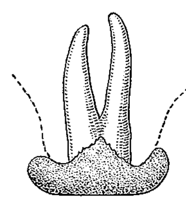


FIG. 173

In such a case it is plainly impossible to get an accurate impression with plaster. A material must be used which will force the soft tissues away from around its margins, and at the same time give a clear outline of the root. A fairly hard and tough wax is indicated. The writer has for many years used pink paraffin and wax for this purpose. This wax is moulded in the form of a cone, of about the size and shape shown (Fig. 171).

Plaster-of-Paris moulds may readily be made, in which to cast these cones, and it is well to prepare a number, and keep them on hand for use as needed. The cones are used nearly full hard, being warmed slightly by holding in the hand for a moment before using. The point of the cone is then placed in the center of the root (Fig. 172), holding it in place with the thumb. Pressure is gradually applied and as the cone softens slightly from the heat of the mouth, the wax is spread out over the stump, and the tissues are forced away from around the margin of the root (Fig. 173). This is necessarily somewhat painful, but it does not last long, and the patient never objects. After it has been pressed up as far as necessary, it is removed. By this means a clear sharp impression of the outline of the root can be obtained, even though it be decayed far below the alveolar border (Fig. 174). The model is now made from this impression.

Preparing the Models.—The model can be made of oxyphosphate of zinc if so desired, but one made of hard plaster will answer every purpose. The plaster is mixed very thick, the impression is moistened, a little of the plaster placed on it and jarred carefully in place. This must be done carefully, so as to make sure that the fine lines will be reproduced. After the plaster has well hardened, the impression is separated from it and the model is thoroughly dried out. It is then trimmed, great care being used not to break the thin edges, representing the thin edges of the root, while following the outline, and cutting parallel with the sides of the root to

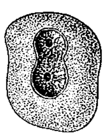


FIG. 174

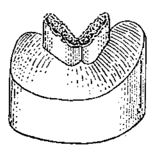


FIG. 175

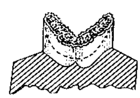


FIG. 176

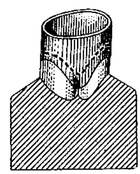


FIG. 177

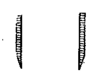


FIG. 178

about one-sixteenth of an inch below the line of decay (Fig. 175). It is then soaked in thin sandarac varnish and again thoroughly dried. The decay having eaten deeply into the center of the tooth, the edges of the stump are very frail (Fig. 176). To lessen the liability of their breaking while fitting the band, the cavity may be filled with hard wax flush with the edges of the stump.

The measurement can now be taken and the band made, fitting it in closely at the constriction between the two roots, and trimming it so that it will exactly follow the outline of the cavity (Fig. 177). The edges are then beveled from the outside, leaving a keen knife-edge on the inside of the band, and it is ready for the mouth (Fig. 178).

The gum around the stump is then cocainized, and the band forced into place, the sharp edges being driven between the root and the process, thus gripping the root firmly.

After the band is in position on the root, the canals can be opened and treated, the band, being firmly fixed, will keep away the soft tissues, blood and moisture. When the band is removed, the stump should be tightly covered with hard gutta-percha to keep the gum from crowding over the face of the root. An ordinary large-headed tack is good for this purpose, covering the post well with the gutta-percha and forcing it into the canal, the excess gutta-percha being forced over the face of the root by the head of the tack. The head can then be covered lightly with gutta-percha and it will keep in position for any desired length of time.

It is more than twenty years since the writer first employed this method of crowning such like roots. It was feared that forcing the band between the root and the process might cause resorption, but he considered the experiment was well worth trying and he has not since regretted it. Since that time, this has always been his method of procedure in these cases, and so far as is known there has not been a single failure. This method may be employed in nearly all cases where the tooth has been broken or decayed below the gum line.

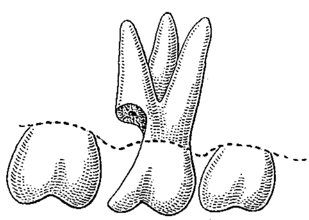


FIG. 179

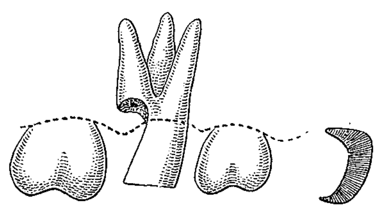


FIG. 180

Another class of cases, which is frequently encountered, is where a large cavity in a molar extends far up on the root beyond the gum margin, as in Fig. 179. The gum should be first cleared from the cavity. This can be done by lancing, or if there is not very much soft tissue in the cavity, trichloracetic acid may be used. Frequently, the impaction of food has kept the cavity partially clear of soft tissues, and it may be possible to force out any remaining tissue by packing gutta-percha or cotton tightly into the cavity, and leaving it there until a subsequent sitting.

The decay is first entirely removed, and the cavity prepared so that it is non-retentive in shape (Fig. 180). If there are any undercuts, they may be temporarily filled with gutta-percha. The remaining sides of the tooth are trimmed so that they are nearly parallel, the same as though preparing the entire tooth for a crown. The cavity is then filled with a slow-setting cement, and this is carefully trimmed, following closely the sides of the root, making sure that the cement does not project in the least, beyond the margins of the cavity, and making the filling nearly parallel with that part of the tooth which remains standing. It should be notched or grooved slightly on the top (Fig. 181).

An impression of the stump is now taken with the cement filling in position. After the impression has hardened, it is removed from the mouth (Fig. 182), and the cement filling (Fig. 183)

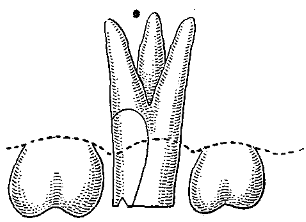


FIG. 181

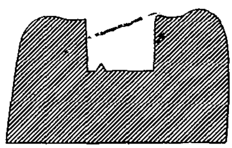


FIG. 182

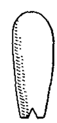


FIG. 183

removed from the tooth and placed in position in the impression, and waxed lightly, as in Fig. 184. The tooth cavity should be packed with gutta-percha so as to keep it open and the margins clear.

The impression is now varnished and a model of hard plaster made from it in the usual manner (Fig. 185). After drying out thoroughly, the model is trimmed to about one-sixteenth of an inch

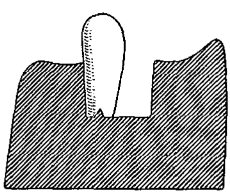


FIG. 184

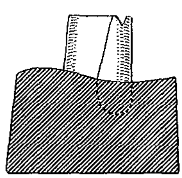


FIG. 185

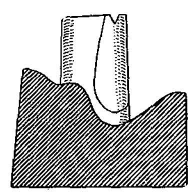


FIG. 186

below the gum line, cutting the plaster away from around the cement filling to about the same depth, thus exposing it and showing the exact outline of the cavity (Fig. 186).

The measurement of the stump should be taken just below the gum line. The band is made, and the gingival end trimmed carefully, so that it follows the outline of the cavity and covers well the line of decay (Fig. 187). The edges are then beveled. It is then tried in the mouth, fitted over the stump, and driven into place. The impression and articulation is then taken, the model prepared and the crown completed (Fig. 188), and after completion, is cemented in the mouth. It will be found to cover the margins and fit the root more perfectly than would have been possible to make it fit in any other way (Fig. 189).

Anterior teeth, such as the centrals or laterals, are frequently found, which have been broken off as from a blow, the fracture on

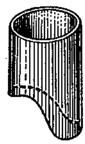


FIG. 187

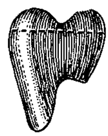


FIG. 188

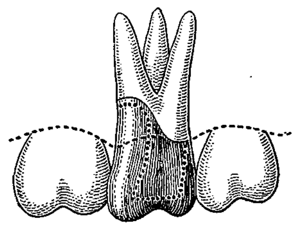


FIG. 189

the lingual side extending far below the gum line (Fig. 190). They should be treated in practically the same way as the molars in the preceding case. The stump standing out of the gum is trimmed very carefully so that the sides are parallel. In this case, much greater care should be exercised to have these sides parallel than where the whole stump is standing and the root has simply to be crowned. The canal is enlarged and a post fitted into it, extending well out of the stump.

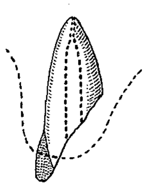


FIG. 190

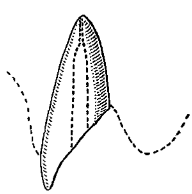


FIG. 191

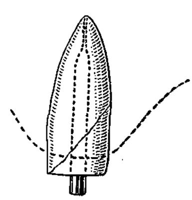


FIG. 192

It is understood that the tissues should be first pressed away (Fig. 191). The fractured part is then built up with cement to about the same height as the part of the stump left standing out of the gum, care being taken to trim close to the margin of the root and make the sides of the cement filling parallel to the standing stump (Fig. 192).

If we have the part of the root which has been broken off, it can be put back in position after removing any of the enamel which may adhere to it, instead of replacing it with cement. The impression is taken with this in place, the same as with the molar. The broken piece of the root or the cement is then removed together with the post, and placed in the impression, and a model made in the manner already described in treating of the molar. The model is then trimmed, carefully, well below the gum margin labially, and below the line of fracture lingually (Fig. 193). The cement and post are

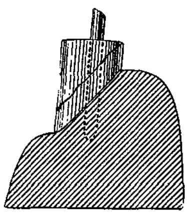


FIG. 193

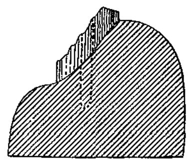


FIG. 194

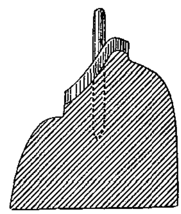


FIG. 195

now removed and the labial side of the stump cut off enough so that the band will be hidden by the gum (Fig. 194). On this model the band is fitted, festooning it carefully so that it will come below the line of fracture lingually, and well under the gum on the labial side (Fig. 195).

If, for this case, a Richmond crown, with a facing and a gold back, or an all porcelain crown with a soldered or a cast base, is to be made, the upper edge of the band may be cut flush with

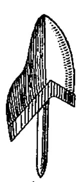


FIG. 196

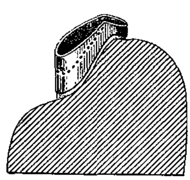


FIG. 197

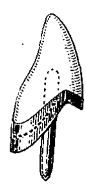


FIG. 198

the edges of the stump lingually, and well under the gum labially and a floor soldered or sweated to it. The post is next fitted and waxed in position and soldered to the floor of the cap (Fig. 195). This completed cap is then placed on the root in the mouth, an impression and articulation taken, the model prepared and the crown made and finished in the usual manner, carrying the solder down to the edge of the band on the lingual side (Fig. 196).

Where it is intended to use a facing, building up the lingual side with porcelain, the band and floor are made of iridio-platinum. The band on the lingual side should extend at least one-thirty-second of an inch above the line of fracture (Fig. 197). On this side a floor should be fitted to the inside of the band over the broken face of the root, allowing the band to extend above it, but on the labial side it can be brought over the top of the band and well under the gum. The band extending above the floor of the cap on the lingual side forms a protected seat in which porcelain is baked so that there will be no thin margins of porcelain which would be liable to crack and flake off (Fig. 198).

PORCELAIN BRIDGES.

The porcelain bridge as advocated by many dentists some years ago has become nearly obsolete. Porcelain is a fragile material, it cannot be made sufficiently strong to withstand the force of mastication without great depth and bulk of porcelain, as the strength of porcelain is only in proportion to its bulk.

Where the posterior teeth have been lost it is, in the majority of cases, necessary to open the bite. By doing this the masticatory force is greatly increased, and there is no porcelain made which will withstand the strain, unless, as before stated, the bridge is made with great depth and bulk of porcelain, or the patient is wearing a plate in the opposite jaw.

Taken purely from an esthetic point of view, porcelain is the ideal material to use, but from a practical standpoint, it is not so ideal. A porcelain bridge would stand better if it were a fixed bridge than it would if it were removable, as the springing which occurs in removing and replacing the appliance will, in every case, sooner or later, cause a checking of the body, necessitating constant repairs.

RELATION OF PROSTHODONTIA AND ORTHODONTIA.

Quite frequently when the services of an orthodontist has been employed the coöperation of the prothodontist is necessary to complete and render his work permanent. Where the teeth have been regulated in mouths where some of the teeth have been lost, it is necessary to restore these lost organs by some rigid fixture, otherwise the teeth which have been put in proper occlusion will quickly return to their former condition. Where such conditions exist, there is no appliance so far suggested as satisfactory and efficient as a properly constructed bridge.

In a large number of these cases the patient is too young to have any permanent appliance made which would necessitate the devitalization of a tooth. Where this is so a temporary bridge can be made, the abutment teeth being trimmed only just enough to allow of the passing of the band between them and the adjoining teeth, but not cutting through the enamel.

The bridge can then be made and cemented into position, and should be carefully watched until the patient is old enough to have a permanent fixture made. Generally this is not advisable until the patient has reached the age of at least eighteen years.

There are many cases where slight irregularities of the teeth brought about by the loss or decay of others can be, previous to crowning, easily and quickly corrected without employing the services of an orthodontist.[1]

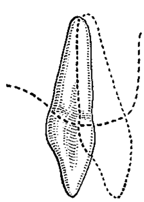


Fig. 199

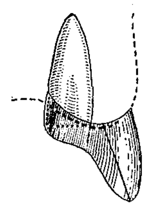


Fig. 200

An example of this would be where a tooth, say a lateral incisor may be standing a little distance inside of the arch (Fig. 199). It has been the custom with some dentists to cut off such a tooth, making a cap for it and letting the floor extend over the ridge to a point in line with the labial face of the adjoining teeth. The facing is then ground in position, backed and soldered, with the backing carried lingually, and over the root cap, so as to bring the facing into proper position, as in Fig. 200. This is not good practice if it can possibly be avoided, as it makes a weak and uncleanly appliance.

It is better that this root or tooth should be brought out in line with the other teeth before attempting to crown it. This can often be done in a few days with some little simple mechanical appliance.

One of the simplest appliances for this purpose would be a piece

[1] The writer is not posing as an orthodontist and does not intend to give any advice as to the regulating of teeth except in cases where the irregularities are so slight that they may be corrected in a few days.

of spring wire attached to the adjoining cuspid and extending over a few of the teeth adjoining. To this the lateral can be attached with a ligature and by tightening it frequently the teeth can be brought in line very quickly. If the crown is lost a staple or hook can be placed in the root and the ligature attached to that.

Another appliance, which can be quickly and easily constructed and which gives a more positive pressure than does the spring wire, is made in two parts. The first consists of a platinized gold bar, heavy enough to resist the strain and long enough so that the ends will rest on the adjoining teeth. A hole is drilled through at a point opposite the lateral which is to be moved. The second part is a small round rod of the same metal, one end of which is shaped so as to form a hook and the other end having a thread cut on it to which a nut has been fitted.

The rod is hooked to the staple or other fixture in the lateral, the other end passed through the hole in the bar and the nut screwed on. By tightening this nut frequently, the tooth or root is quickly and easily brought in line (Fig. 201).

In cases where the space for a lateral or a central incisor is nearly closed, and it is necessary to move a number of the teeth in order to make room, it may be advisable to employ the services of an orthodontist.

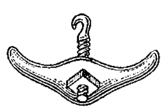


FIG. 201

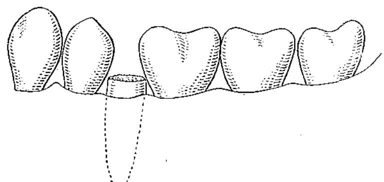


FIG. 202

Another class of cases of slight irregularities which are very frequently encountered is where the crowns of certain teeth are lost and the adjoining teeth have moved together, so as to partially close the space and there is not enough room to insert a crown of normal size. In fact, quite often the space may be narrower than the width of the broken-down root. This is frequently seen where the crown of a first or second bicuspid is lost, and the adjoining bicuspid and molar has moved forward so as to partially close the space as in Fig. 202.

It would be bad practice to place a crown on a root, where these conditions exist, without first forcing them apart so as to get room enough in which to place a crown of normal size. This can be done easily and quickly, in the majority of cases, even when none of the molars are missing, without making any mechanical appliance at all, but simply by wedging.

If the three molars are standing, and the second bicuspid missing, the first step would be to put a blocking of wedges tightly between the molar and the first bicuspid, so that the molars could not move forward. Then begin by making a separation between the second and third molars, starting at first with as large a piece of separating-rubber as can be placed between these teeth. After they have been forced apart, somewhat, the work of separating may be completed with orangewood wedges. The space between is dried out and a piece of well compressed orangewood is driven in between the teeth as tightly as possible. As the wood becomes moistened, it expands and forces the teeth still further apart. This is repeated until the amount of separation between the second and third molars, added to that of the space of the first molar and first bicuspid will give sufficient space for a crown of normal size.

The next step is to start wedging between the first and second molars, at the same time easing up, as progress is made, the separation between the second and third molars, wedging with the orangewood until the second molar has been forced back against the third.

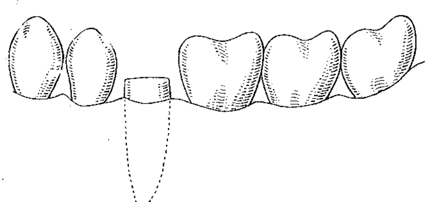


FIG. 203

There now remains only the one tooth to be moved to its normal position, the first molar. This is moved in the same manner as the others, by increasing the size of the wedges between the first bicuspid and first molar, and decreasing those between the first and second molars, and keeping this up until a little more space than is necessary for a normal sized crown has been secured, (Fig. 203). The space should be carefully preserved with wedges until the root is prepared and the crown made, and in place, otherwise the molars would quickly resume their former positions.

It has been claimed that the third molars cannot be forced back but with this the writer cannot agree, as it has been done many times, in the manner stated.

There are many cases where the work of securing a separation can be done entirely by the patient, especially if the third molar or second and third have been lost. The first step is to cut an orangewood stick of such a length that it will wedge in tightly between the bicuspid and the molar, concaving it a little at each end so that it cannot be forced out bucally or lingually. A number of these orangewood plugs are prepared, each one a little longer than the others, the last one being slightly longer than the space which is needed for the crown (Fig. 204). They are numbered 1, 2, 3, etc., beginning with the shortest which is numbered 1. The No. 1 plug is now forced into position between the bicuspid and the molar (Fig. 205). The others are placed in an envelope on which instruc-

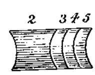


FIG. 204

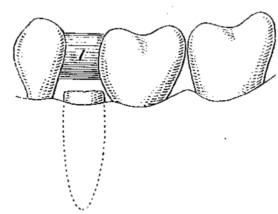


FIG. 205

tions are written, and given to the patient, the instructions stating that as soon as the wedge which is in the mouth has become loosened somewhat, so that it can be moved easily, the No. 2 is put in position and bitten into place. This is repeated as soon as the No. 2 is loose, the No. 3 is forced in place and so on until the last one is in. The patient is instructed to return after the last plug has been in place for three or four days.

It will be found that in the majority of cases the teeth can be moved for a considerable distance in ten days or two weeks with practically no pain to the patient. As the teeth are forced apart they are held perfectly rigid, so that there is no movement which will keep up an irritation.

The same method of gaining space may be adopted in the anterior part of the mouth. Many times, where the crown of a tooth has been broken away, say that of a central, or where the central root is missing, the remaining central and lateral will come together so that perhaps the space between them is less than half the width of the remaining central (Fig. 206).

In such a case a crown on the root or a bridge restoring the missing tooth should not be placed unless the tooth can be made of a size corresponding very nearly to that of the remaining central. If a narrower crown is placed, one not nearly as large as its mate, it is unsightly, and these teeth should always be separated so as to make room for a tooth of normal size.

This can usually be done in exactly the same manner as has already been described in speaking of the bicuspid. Sometimes in forcing the teeth apart in this manner there will be a tendency for them to overlap and pass each other. This difficulty can generally be overcome by ligating.

It not infrequently happens that it will be found that one of these teeth has been loosened, perhaps from a blow, which has

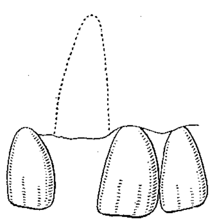


Fig. 206

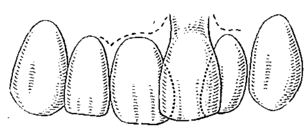


Fig. 207

destroyed the bony attachment and is holding only by the gum and is laying over the labial side of the adjoining teeth. The remaining central and lateral will have closed in behind it. For esthetic reasons the patient may not wish to have the injured tooth removed without having something which can be used temporarily while the permanent fixture is being made restoring a central of a size corresponding to the one remaining.

As an illustration the following description of a case of this kind which came under the care of the writer will serve.

The patient, a lady over fifty years of age, several years previous had received a blow in the mouth which had loosened the left central incisor. The condition had become worse, until it had only a slight gum attachment and the tooth was practically held in position only by the lip (Fig. 207). An impression of the parts was taken and a model carefully prepared. The cast of the loose tooth was then cut from the model (Fig. 208) and the model separated by saw-ing through between the remaining central and the lateral. The halves of the model were then forced slightly apart and a tooth, matching the other central in shade, was ground to fit in this space and the outer edges slightly beveled lingually. A thin backing was then fitted to the lingual side of the facing extending beyond it mesially and distally and this extension burnished over the lingual side of the adjoining central and lateral (Fig. 209). This was

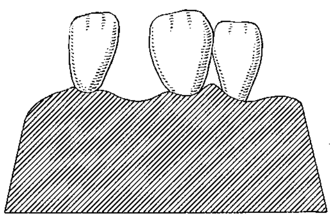


Fig. 208

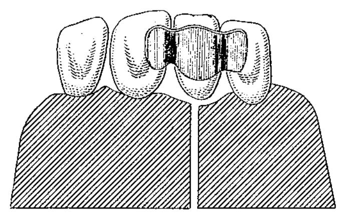


Fig. 209

then waxed and invested and covered over with solder. The model was then separated a little farther and another and larger facing ground in place and backed and prepared in the same manner. A third and fourth facing were prepared the same as the others, the last of which was as wide or a little wider than the space required. The teeth with the backings were made in such a way that they would wedge between the central and lateral but could not be forced either labially or lingually (Fig. 210, *a* and *b*).

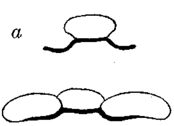


Fig. 210

The patient was then sent for, the loose tooth removed and the smaller of the backed facings was forced in between the central and lateral. The patient was then given some narrow linen tape and was instructed that as soon as the appliance had loosened a little to put a thickness of the tape between the sides of the appliance and the adjoining teeth, and to keep this up until there were three or four thicknesses in place, and then wear it until the piece became slightly loose again.

In the meantime, the work of devitalizing the adjoining teeth and preparing them for a bridge had been progressing. As soon as the smaller appliance had forced the teeth apart, so that it was loose when worn with several thicknesses of tape, the second appliance was put in and the same directions given regarding the tape. After that had served its purpose the third and then the final appliance was put in position and worn until the permanent fixture was ready to be put in position.

Tube and inlay attachments were used in this case, and the bridge made to fill the space, the temporary appliances being worn in the meantime, and discarded only when the bridge was ready for the mouth. This made an easy and certain way of getting the needed separation, and during which time the patient was spared the disfigurement which would have been caused by an ordinary separation, and only those intimately acquainted with her knew that there was a tooth missing.

CHAPTER IX.

PROSTHESIS.

AUTOGENOUS SOLDERING, OR THE "SWEATING PROCESS," AND SOLDERING.

THERE are two methods in use, where constructing crown and bridge-work, for the making of caps and bands, or uniting pieces of gold of the same carat. First, that of melting or welding the parts together without the use of solder and which is known as the "sweating process," or to use a more scientific term, "autogenous soldering." And second, soldering, by the use of alloys a trifle more fusible than the metals to be united, fused between and over the surfaces to be joined, uniting them firmly together. These alloys, termed solders, may be of various grades of fineness, or be of the same grade and yet vary a great deal in point of fusibility. These variations depend upon the kind and quantity of alloy used. As a rule, the higher the carat, or the nearer the fusibility of the solder approaches that of the plate, the stronger will be the union. The higher the fusing point of the solder the less alloy it contains, or the alloy used is, in character, more like the plate.

Autogenous soldering, or sweating, at its best, makes by far the strongest union. Its chief merit in crown and bridge-work is that it is not re-fused in subsequent solderings. In favorable positions, with a little practice, the art of autogenous soldering is easily acquired, and the union is very satisfactoy. It requires, however, a steady hand, a good blowpipe well managed, and a fair degree of "knowing how," that can be acquired by practice only, to so heat two pieces of metal that the surfaces in contact are fused while the body is near to but not actually at its fusing point. Under these conditions there seems to be a molecular attraction between the fused surfaces and they flow together and unite. A little less heat, and the operation is a failure, a little too much, and the appliance is ruined. The real secret of success is in knowing how far to go, and when to stop. When once the "knack" is acquired, it is surprising how seldom "just right" is missed, and how, as one advances in experience, quickly and with certainty complicated pieces are united by the sweating method. In fact it is more quickly and easily done and with less liability of burning than where solder is used.

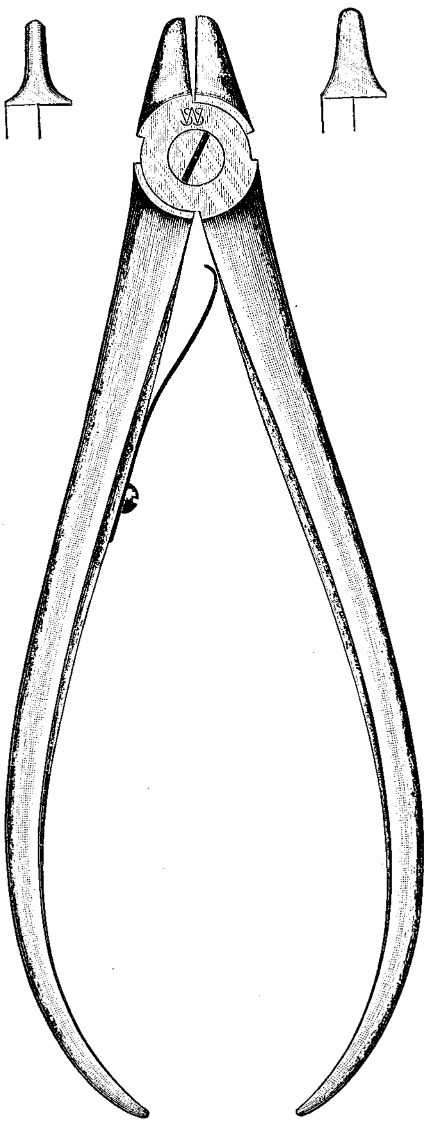


Fig. 211

When a band has been joined by this method, there has been a molecular change in the metal so united which renders it somewhat of the nature of cast gold. It has not the same tenacity and strength at that point unless it has been well overlapped. In order to overcome this weakness and bring about a rearrangement of the molecules, the band is placed over the beckhorn of an anvil with the seam uppermost, and the seam is hammered until it is of the same thickness as the rest of the band, and has become entirely obliterated. This forging condenses the gold and restores its tenacity, and makes the band practically seamless, and as strong where it has been joined as at any other point.

Flattening the seam or stretching a band may be done as well by compressing it between the beaks of a powerful pair of pliers which were designed by the author for this purpose and are known as "stretching and contouring pliers" (Fig. 211).

Another advantage of the sweating process is that the seam or joint will not discolor after the appliance has been worn in the mouth for some time, as does a seam or joint made with solder.

Another point in favor of the sweating process is that a cap or a crown built up by soldering and used as an abutment for a bridge, is much more easily burned in any subsequent resoldering operations to which it may be subjected than is a sweated crown. The reason for this is very simple and should be understood by every one doing metal work.

In using solder, the surface of the gold to which the solder is applied becomes alloyed, the depth to which this alloy extends depending upon the carat, the character, the amount of solder used and also the amount of heat to which the mass has been subjected

FIG. 212

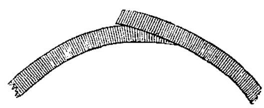


FIG. 213

in melting the solder. The carat of the gold has thus been lowered, sometimes to the entire depth of the thickness of the band. The result is, that in such a band, we have already a much lower carat at the point of union than we had at the beginning and far greater care must be exercised in any subsequent solderings with the consequent greater danger of burning the band.

If solder is used for uniting the bands and caps, it should be used in small quantities, and of as high a carat as the gold will stand.

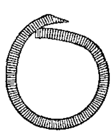


FIG. 214

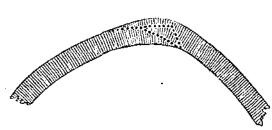


FIG. 215

This can easily be of the same carat as the band, as solder will fuse at a lower temperature than plate of the same carat. Thus, 22 carat solder can be used in soldering 22 carat plate.[1]

When preparing a band for soldering, it is optional whether to unite the ends by an abutted joint, or by lapping them one over the other. An abutted joint is not as strong as one lapped. It is also more difficult to bring the abutted ends into perfect contact and

[1] The carat of gold depends upon the quantity of alloy only. The fusing point upon the quantity and character of the alloy. Any carat may be high fusing or low fusing.

11

hold them so while uniting them than it is to adjust and hold in contact the ends of a band with a lapped joint. However close an abutted joint may be, the parts are not in actual contact, and after it has been sweated together, it will be really a little thinner at that point, than the band was originally (Fig. 212) thus weakening it somewhat.

In making a lapped joint there is no necessity for beveling more than one end of the band. The beveled end is brought around and under the end which has not been beveled, sufficiently far to well overlap it, as shown in Fig. 213. Then, the overlapping end is brought back a little, and pressed downward under the other (Fig. 214) so that when it is again restored to its proper position the elasticity of the metal will hold the two ends in close overlapping contact.

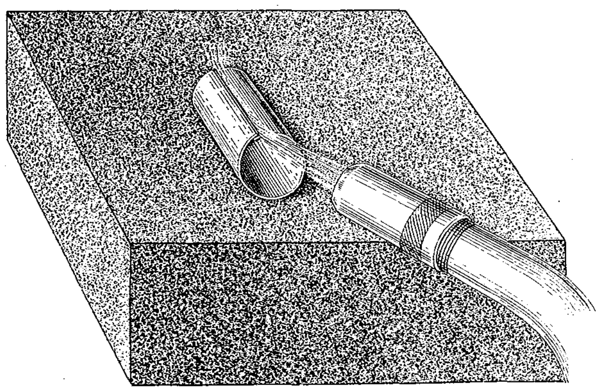


FIG. 216

The joint is then sweated together, melting the overlapping edge well down (Fig. 215). The joint is next hammered on the anvil beak, or flattened with the stretching pliers until the seam on the inside has been entirely obliterated.

Several different flames may be used in the sweating process, usually, however, after one has mastered the principles involved, the details become a personal matter, and are modified to suit the operation.

After the ends of the band have been brought into contact and fluxed, it is placed with the lapped edge uppermost on a piece of charcoal. An asbestos block may be used, but it is not as good as the charcoal. Charcoal is cleaner, and reflects the heat, which materially aids in the operation. The blowpipe is employed, using a small brush flame until the band is brought to a red heat, almost to the point of fusing. As it begins to glisten, showing that the surface is nearly ready to fuse, the flame is shortened to about from an inch to an inch and a quarter in length and passed slowly along the joint, using the inner point of the blue flame, until it is perfectly united along its whole length (Fig. 216).

Another method is to sweat the parts together entirely with the brush flame. The band is placed in the same position on the charcoal as in the previous method, and the large brush flame is applied, holding it on the band until it begins to fuse. As soon as the parts are united, the flame is quickly removed.

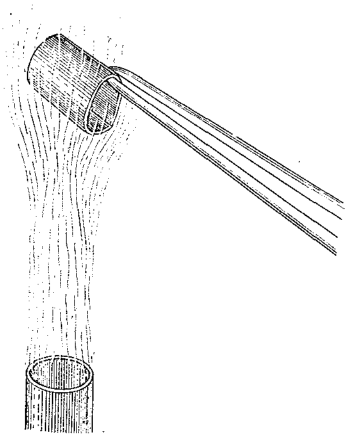


Fig. 217

Still another method is to invert the band, having the seam downward. It is then caught lightly with a pair of soldering pliers and held in the Bunsen flame and watched carefully until the gold is seen to melt when it is quickly withdrawn (Fig. 217). The joint is then hammered on the beckhorn of the anvil obliterating the seam. This later method is perhaps easier than are the others and will probably be favored by the majority of those doing this work.

CLEANSING GOLD AFTER ANNEALING OR SOLDERING.

A 50 per cent. solution of sulphuric acid, technically termed "pickle," is used for cleansing the surface of gold after annealing and for removing the oxidation and fused flux after soldering. This acts without heat if given sufficient time; it is usual, however, to keep the pickle in a porcelain evaporating disk mounted so that it can be boiled, to hasten the operation. There is always more or less unpleasant fumes given off by the acid, especially when it is boiled. Where much work is done it is best to provide a hood or small closet with a door which can be tightly closed, and with a vent to the outside of the building to carry off the fumes, in which to keep the acid. Small pieces can be boiled in a test tube more conveniently than in the dish, they are, however, very fragile, the work must be allowed to slide in gently, if dropped in the tube will in all probability be broken.

Dilute hydrochloric or muriatic acid is also used for cleansing the gold. It does the work equally well, but should never be used except in a tightly closed closet as the fumes are most corrosive and if left exposed will quickly ruin all the steel instruments in a laboratory.

It is desirable to have at hand a solution of bicarbonate of soda in which to rinse work taken from the pickle, especially if it is to be immediately fitted in the mouth. It promptly neutralizes the unpleasant acidity of the pickle.

When annealing small pieces of gold, or cleansing bands or shell crowns preparatory to soldering, they may be brought to a red heat and then plunged into the cold pickle, but where porcelain is present it is necessary to boil the work.

A saturated solution of alum, used boiling, is quite satisfactory for pickling, and very much more pleasant to use, although not quite as convenient, as it must always be boiled. It may be kept in a narrow lipped pitcher, and when required for use sufficient to well cover the work poured into a porcelain or copper dish in which it may be boiled. When the work is clean, the alum solution is poured back into the pitcher and the work rinsed with water while still in the dish. The alum solution is not corrosive, as is the acid, and is not destructive to clothing, etc., if spilled.

GOLD ALLOYS USED FOR MAKING BANDS AND CROWNS.

The gold alloy used for making bands and crowns should be sufficiently pliable to permit its accurate adaptation to the stump or root, and at the same time should be hard enough, and possessed of sufficient tensile strength so that there will be no liability of its stretching out of shape, and so defeating the object for which the band was designed. It should also be of a sufficiently high carat to withstand the oral secretions.

An alloy of gold and silver is more easily adapted than is a harder alloy, but is too soft to give the best results, especially for crowns used as anchorages for bridge-work. A tight fitting band of this alloy driven over a stump is likely to become buckled and distorted. A gold alloy possessing the properties of American gold coin as regards strength, rigidity and elasticity, is more suitable for this purpose than is the ordinary twenty-two carat gold of the dental depots.

Although coin gold is somewhat more difficult to manipulate than is the other, it will make a far stronger and more lasting band or crown, and is much to be preferred, especially if the band or crown is used as an abutment for a bridge.

The copper in coin gold gives it a deeper color than has the same carat with a large proportion of silver in the alloy. Some object to it for this reason, but the writer prefers the deep rich reddish color of the coin rather than the light lemon color of the twenty-two carat gold plate of the dental depots. There is very little difference in the carat of the two alloys, the coin being 21.6 carat, or 900 fine, and the other 22 carat, or 916 fine.

RELATIVE MERITS OF SWAGED SEAMLESS CROWNS AND BUILT UP CROWNS WITH SOLID GOLD CUSPS.

There have been a number of outfits placed on the market for making of seamless gold shell crowns. Some are more elaborate than others, but there seems to be very little difference in the quality of the work done by these different devices.

The seamless shell crown does not meet the writer's approval. It must be made of a soft metal, and therefore it possesses very little strength, and should be used only as a temporary appliance.

In making these crowns, the metal, at every part except at the gingival edge, is stretched during the operation of contouring and forming the cusps, so that the metal necessarily becomes very much thinner than it originally was, and this is especially true of the metal on the occlusal surface of which the cusps are formed.

Many of these crowns are cemented in position without any reinforcement of the occlusal surfaces, with the result that within a very short time they are worn through, the cement is disintegrated, and the operation soon becomes a wreck. It should be a general custom, when these crowns are used, before cementing them in place, to flow solder into the caps, filling the cusps well so as to stiffen them and enable them to withstand the strain and wear of mastication.

It not infrequently happens that in contouring and in forming the cusps, that the gold is over-strained, and there will be minute cracks in the fissures which extend entirely through the gold, but are so minute as not to be noticed. In flowing the solder into the cusps, it is rarely that it will overflow the fissures which are the highest points in the inverted cusps, but it will always drop into the cusps which are the deepest part of the crown (Fig. 218).

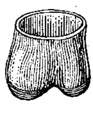


FIG. 218

When cemented in place, the crown may protect the tooth for a time, but the moisture and fluids of the mouth will be carried through these cracks in the fissures, disintegrating the cement, causing decay and many times the tooth is entirely ruined before the patient is aware that there is any thing the matter with it, the same as when the cusps have been ground through.

This very often happens where a crown of this type is used for an attachment for a bridge, another abutment perhaps holding the bridge in place so that the patient is not conscious of any change which may take place until it is too late to save the tooth.

Another objection to this crown as an attachment, aside from the possible defects already mentioned is that a crown of this type is not of sufficient strength to give support to a bridge. Being made of such thin and soft material, if there is much stress on the bridge, the side of the crown is frequently torn out at the point where the dummies are united to it, and the whole piece is rendered useless.

Again, if the crown is made to fit the stump, accurately contoured as it should be contoured, and carefully articulated, it will take a much longer time to make it with any of the seamless crown appliances that are on the market than it would to make an accurately contoured and solid cusp built-up crown, while there can be no comparison as to the strength and lasting qualities of the two crowns.

As before stated, these crowns may be used for a temporary protection of the natural crown of the tooth, but should not be considered in permanent work.

HOW TO USE THE SHEARS IN FESTOONING A BAND.

In festooning a band, the flat side of the scissors or the inside of the blade should always be placed next to the band. If cutting to an outside mark, the edge which is being trimmed should be to the left, the flat of the scissors placed against the edge and cutting from the top of the band, as in Fig. 219.

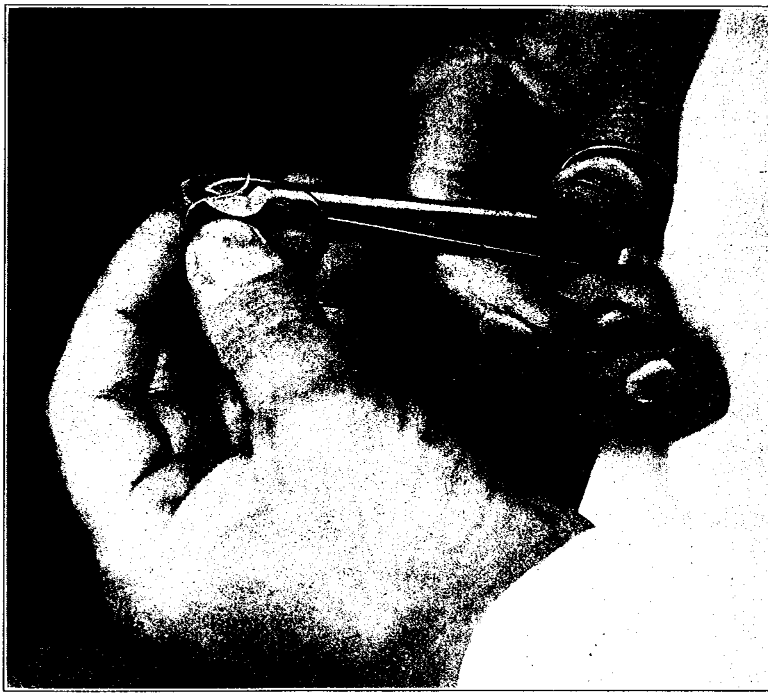


Fig. 219

If cutting to an inside mark, as where the inside of the band has been scribed around the top of the stump, this edge of the band should be turned to the right, placing the flat of the scissors on the lower side and following the marks (Fig. 220).

If the outside of the blade is placed against the metal, it will be impossible to festoon it without distorting the band.

Fig. 221 shows curved crown shears.

Fig. 222 shows straight crown shears.

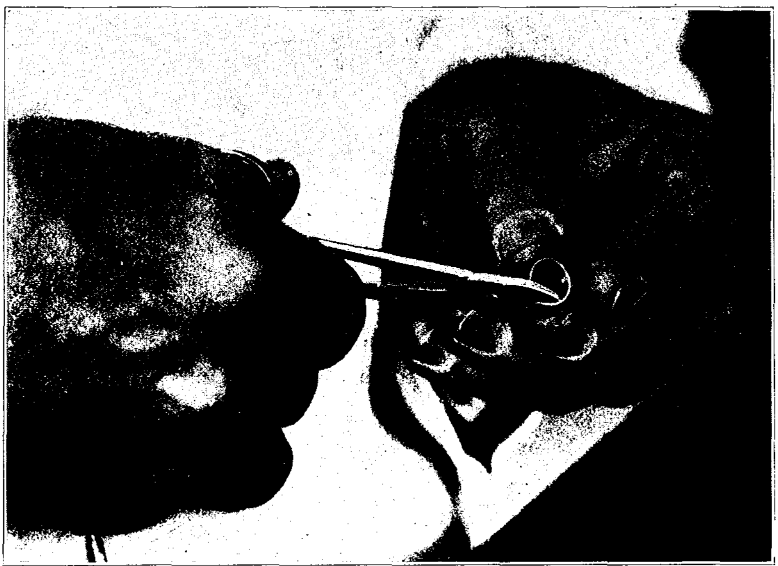


Fig. 220

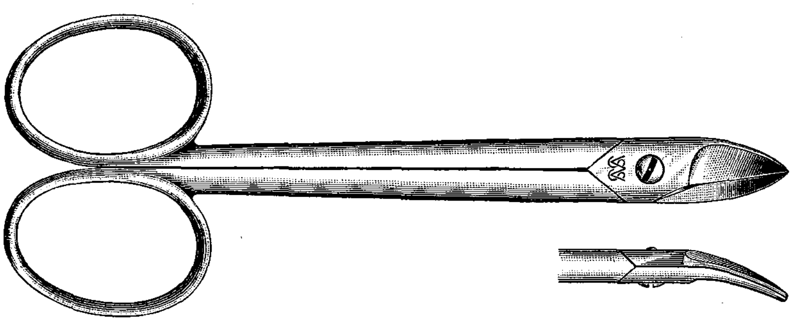


Fig. 221

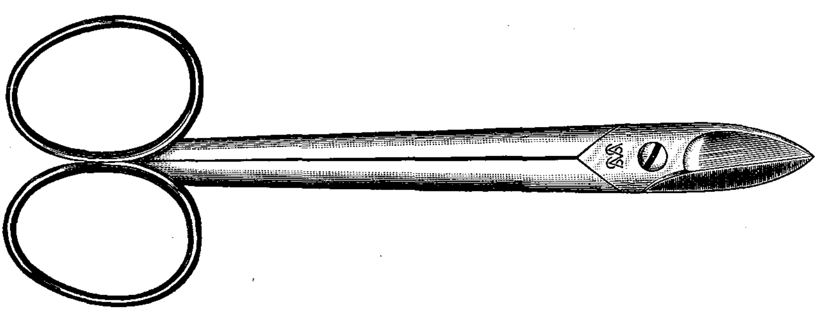


Fig. 222

Characteristics of the Cusps of Upper and Lower Bicuspid and Molar Teeth.—In making a selection of cusp buttons or moulds to serve as models from which to make the occlusal face of bicuspid and molar crowns or in carving the cusps it is important to have a general idea of the characteristic or typical form of the cusps of the natural bicuspid and molar teeth. Although there are slight variations, each normal tooth has certain characteristic markings, or cusp forms, which indicate at a glance the position it should occupy in the mouth. These will now be considered; they should be borne in mind when selecting the model for or carving the cusps of bicuspid and molar crowns.

Upper First Molars.—Looking at the first upper molar from the occlusal surface, it will be seen that it is diamond-shape, the greatest diameter being from the anterior buccal to the posterior palatal corner (Fig. 223), and also in the outline drawing of Fig. 226, the outside line showing the outline of the first molar. These teeth have four cusps, the buccal and lingual being very different in

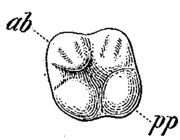


FIG. 223

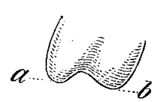


FIG. 224

shape from each other. The lingual aspect of the buccal cusps slope inward to the fissure on nearly a straight line, the mesio-buccal and disto-buccal cusps being nearly of the same size and with a prominent ridge near the center of each cusp; the buccal occlusal points being fairly sharp (Fig. 224 *a*).

The *lingual cusps*, on the contrary, are large and well rounded (Fig. 224 *b*), the disto-palatal being entirely separated from the other cusps by a deep fissure extending from the middle of the distal aspect to midway on the palatal side of the tooth (Fig. 223). This cusp is distinctly different in shape from the others and will always indicate on which side of the mouth the tooth belongs.

The Upper Second Molar.—In studying the upper second molar closely (Fig. 225), it will be found, on looking at the occlusal surfaces, that they are very nearly of the same shape as are the first molars, with the exception that the diameter of the tooth from the anterior buccal to the posterior palatal corner is slightly less proportionately than it is in the first molar, as will be seen in the lines in the drawing (Fig. 226), the middle line in the posterior palatal corner representing the outline of the second molar. It is also to

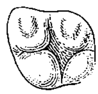


Fig. 225

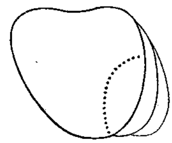


Fig. 226

be noticed that the disto-palatal cusp is smaller and not so well defined as it is in the first molar.

The Third Molars.—With the third molar where there is the normal number of roots, will be found the same general shape prevailing as in the other molars (Fig. 227), but in the third molar the diameter of the tooth from the anterior buccal to the posterior palatal is still further decreased, and in many cases will be found to be less than the disto-buccal to the anterior palatal (Fig. 226), the inner line at the posterior palatal corner showing the outline of the third molar. The disto-palatal corner also is still further rounded so that the occlusal end of the tooth frequently presents a triangular or rounded appearance rather than the typical diamond-shape. Often, too, the disto-palatal cups will have almost entirely

Fig. 227

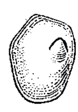


Fig. 228

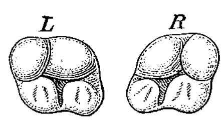


Fig. 229

disappeared, but still in nearly every case, there is to be found some trace of it, and the cusps may appear simply in rudimentary form on the disto-palatal corner of the tooth, below the line of the other cusps, as in Fig. 228. It is very rarely that all traces of it are absent.

Where a number of upper molar cusp buttons, both for the right and the left side have been mixed together, they can readily be distinguished and separated by placing them on the table cusp up, and with the buccal side toward the viewer. Take note of the disto-palatal cusp, and whichever way that points, whether to the right or the left, the cusp is for that side of the mouth (Fig. 229). A knowledge of this fact facilitates very much, not only the separation of the cusp buttons of the right side from those of the left, but the character of the palatal cusp, together with the general outline of the crown, will indicate whether it be the first, second or third molar.

Lower Molars.—In the lower molars, the shape of the crown of the tooth is very different from that of the uppers. Viewed from the occlusal surface, it is in the form of a parallelogram, the mesio-distal diameter being much greater than the bucco-lingual. It is also frequently slightly broader at the mesial side than at the distal (Fig. 230).

Lower First Molar.—The lower first molar has five cusps and in this instance we have the reverse of the upper molar, the sharper cusps being the lingual (Fig. 231 *a*) and the broad and rounded cusps being the buccal (Fig. 231 *b*). This must of necessity be the case in order

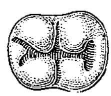


FIG. 230

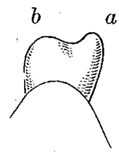


FIG. 231

that there may be a perfect occlusion, as in Fig. 232. On the buccal side there are three cusps, the mesial cusp and the middle cusp being the larger. The fissure between these two is a little anterior to the center, while the distal cusp is the smallest of the three, the fissure extending generally from about one-sixteenth of an inch from the disto-buccal side of the tooth diagonally toward the center (Fig. 233).

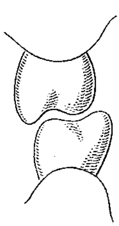


FIG. 232

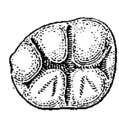


FIG. 233

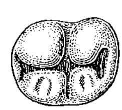


FIG. 234

The anterior sulci will be found fairly close to the mesial face of the tooth, being broad and extending buccally and lingually across about one-third to one-half of the width of the tooth. Distally the fissure is forked, one branch separating the middle and distal cusp and the other reaching in an opposite direction toward the lingual side of the tooth. The shape of the cusps and the character of the fissure are the distinguishing marks of these teeth.

Lower Second Molars.—In the second molar, there are but four cusps, the two sharper cusps lingually, the two buccal cusps being broad and rounded and of nearly equal size. This also has the broadened fissure in the anterior part of the cusp, the same as the first molar and also the fissure is forked distally, the structure between the fork forming a rudimentary fifth cusp in the middle of the distal side of the tooth (Fig. 234).

Lower Third Molars.—With the third molars or wisdom teeth, the crown is generally smaller and narrower than are the other two molars. The cusp may be similar in character to the second molar, but this tooth is subject to a much greater variation than are the other two, and in fact at times the character and arrangement of the cusps are entirely different not only from any other tooth in the mouth, but from any other human tooth.

The difference between the rights and lefts in the molars of the lower jaw is not so marked as it is in the case of the upper, and occasionally it is so slight that they may be used interchangeably. This is especially true if it is desirable to cross the bite so that the lower molars will bite outside the upper rather than on the inside. In this case, the cusp of a right lower molar may be used on the left side or that of a left may be used on the right, so as to bring the broad buccal cusp on the lingual side, thus giving a broader occlusal surface.

Again, the cusp might be reversed end for end so as to secure a better occlusion, and then, after a little carving, it can be made to represent the tooth which is being reproduced.

This interchangeability will very rarely work in the case of an upper molar. It should be remembered in this connection, that the one thing for which the operator is working is to restore the mouth to as nearly a normal condition as possible, and in order to do this, it is absolutely essential to secure the most perfect occlusion it is possible to obtain.

The Upper Bicuspids.—In the upper bicuspids, as the name implies, there are but two cusps, the buccal cusp being sharp, as in the case of the buccal cusps of the upper molars, and very similar in character, while the lingual cusps are more rounded, although not to the same extent as are those in the molars. The first bicuspid is the larger of the two, but the character of the cusps of the two are nearly identical.

The Lower Bicuspids.—The first bicuspid has a long sharp buccal cusp, but there is very little in the way of a lingual cusp. In fact, this tooth often presents the appearance of a cuspid with simply a rudimentary cusp on the lingual aspect of the tooth just above the basilar ridge and is of no assistance in mastication.

With the second bicuspid, which is larger than the first, the buccal cusp is not so high nor so sharp as that of the first. The lingual cusp is broader and flatter than that of the first, and is often divided so as to form what might be called a tricuspid.

Both the cusps of the upper and lower bicuspids may often be used interchangeably for either side of the mouth, in order to secure better results, and the character of the cusps of the opposite sides is so similar that it is very rarely that the change would be detected.

CONSTRUCTING A BUILT UP CONTOURED GOLD CROWN WITH SOLID GOLD CUSPS.

Taking the Measurement of the Root.—The measurement of the stump or root should be taken straight across and as nearly at a right angle with the sides as possible. It is very rarely that this measurement should actually follow the gum line. Where there has been a recession of the gum on one or more sides of the tooth, if the wire with which the measurement is taken is carried down to these points all around, it will be found that the band, when it is made, will be too large to fit the stump.

As will be seen in the illustration of a lower molar where the tissues are high at the back, but show a considerable recession on the mesial side of the tooth (Fig. 235), if the measurement is

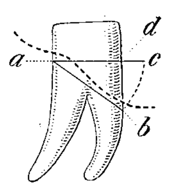


Fig. 235

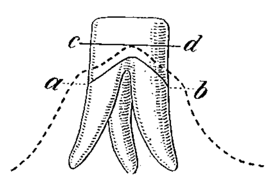


Fig. 236

taken following the line of the gum from *a* to *b*, when it is brought up so that it extends straight across following the line *a* to *c*, it will be much larger than it should be. The wire should be forced as far under the gum distally as possible and then brought straight across to the point *d*. Then, too, in Fig. 236, showing an upper molar with considerable recession of the tissues buccally and lingually, it can readily be seen if the measurement follows the gum line from *a* to *b* that when it was straightened out it would extend from *c* to *d*, with the result that a band made to this measurement would be much too large.

Built up Shell Crowns with Solid Cusps.—A built up crown, with solid cusps, is the best and most enduring crown that can be made, whether used as a single crown or as an abutment for a bridge (Fig. 237).

Where it is necessary to restore very much contour (Fig. 238), the band should be cut on a bevel, measuring from the gingival

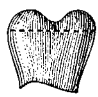


FIG. 237

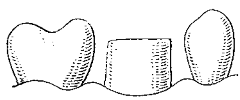


FIG. 238

edge and flaring it outward toward the occlusal, the amount of the flare depending on the amount of the contour which is to be given to the crown (Fig. 239). Where the adjoining teeth have

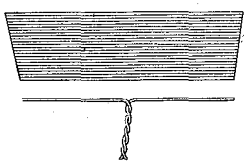


FIG. 239

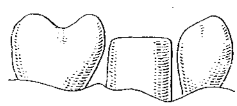


FIG. 240

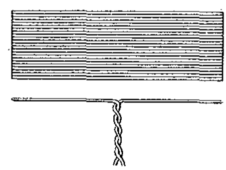


FIG. 241

closed in on the stump, and there is very little or no contour to be restored, as in Fig. 240, the ends of the band may be cut parallel with each other (Fig. 241). If in this case, the band were cut on a bevel and made larger at the occlusal end, when forced onto

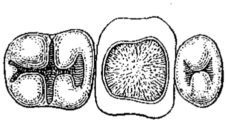


FIG. 242

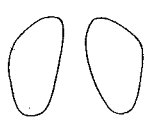


FIG. 243

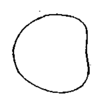


FIG. 244

the stump it would be squeezed together mesially and distally and forced out buccally and lingually beyond the line of the adjoining teeth as in Fig. 242.

One end of the band is then beveled to a knife edge and the ends are brought together and sweated or soldered. The band should now be given the approximate shape of the tooth which is to be crowned (Figs. 243 and 244) and is next roughly festooned so as to follow the gum line approximately (Fig. 245).

The shaping of the bands is best done with the collar pliers shown in Figs. 246 and 247. The beaks of Fig. 246 are very narrow, one having a flat face, the other being rounded and slightly shorter than the other. Fig. 247 is made on the same plan, having one flat and one rounded, but the beaks are much broader than Fig. 246. Fig. 246 is used in shaping

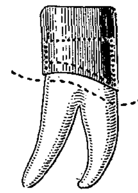


Fig. 245

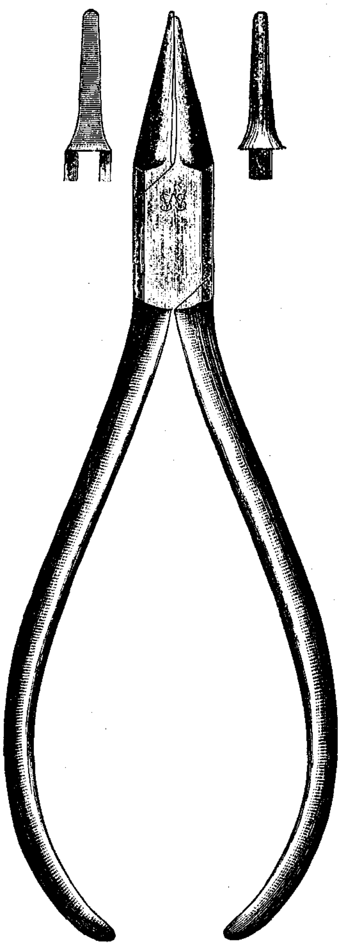


Fig. 246 —Peeso pliers.

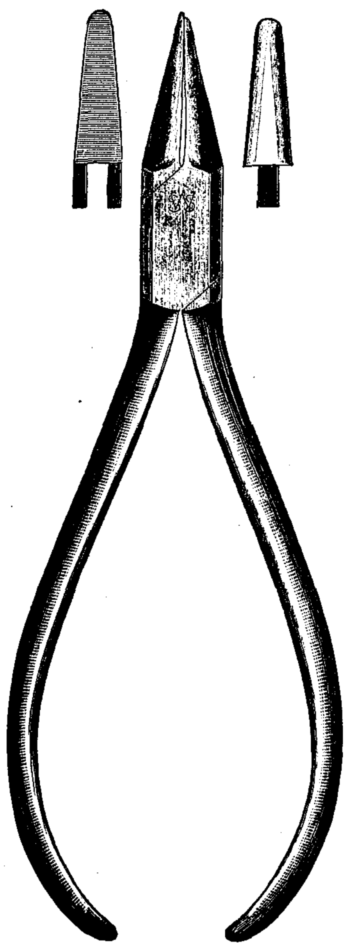


Fig. 247.—Robinson pliers.

lower incisors and other small bands, and Fig. 247 for molar, central incisor and cuspid bands.

The band is placed on a stump and scribed around on the outside with a sharp instrument following the gum line carefully (Fig. 245), after which it is removed and trimmed to the line and the outer edge bevelled so that it will pass under the gum without irritating it. It is then replaced on the stump and forced well down over it. It is again marked, and removed and with a fine file accurately shaped to the gum line, so that it will pass, evenly, about one-sixteenth of an inch beneath the gum all around (Fig. 248). After it is accurately in position the impression is taken.

Fig. 248.—In using the file, the band should be held gingival edge up and filed from the inside outward so as to throw the feather edge to the outside, leaving the band smooth on the inside. The feather edge is afterward removed by beveling the edge of the band on the outside.

The model is cast and prepared as already described when treating of making models. The band is removed by warming it slightly or by grasping it with a pair of warm pliers which softens the wax and allows it to come away from the model. The remaining wax should be burned away and the band cleansed in dilute sulphuric acid. The wax should also be removed from around the stump on the model.

Contouring the Band.—The stretching of the band for contouring may be done on the beckhorn of the anvil or with the stretching and contouring pliers (Fig. 211) as previously described. In stretching the band, whether with the pliers or on the anvil, it is started at a point slightly above the gingival edge, working around the band from this point and gradually increasing the pressure as the occlusal end is approached, giving the band something of a bell-shape, until it is flared somewhat more than enough to give the required contour (Fig. 249).

In using the pliers, one beak of which has a broad flat face, while the other is narrow and has a round face, the smaller beak is placed

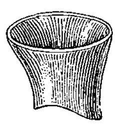


FIG. 249

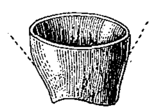


FIG. 250

inside the band and the larger flat faced beak on the outside; the stretching is done by closing the handles lightly and working around the band, gradually increasing the pressure as the work progresses from the gingival to the occlusal end.

The band is then annealed, and with a pair of Robinson pliers (Fig. 247) the occlusal end is straightened so as to give the desired broad point of contact with the adjoining teeth. The edge should not be tipped inward in the least, but the sides should be brought so that they are parallel with each other for approximately about one-third the length of the band, as in Fig. 250.

If the band is simply stretched and not straightened up toward the occlusal end, it will be seen by the illustration, that if the cusp was soldered on and the crown completed, the point of contact would be very slight and the crown would not in the least resemble the crown of a natural tooth (Fig. 251).

If the shaping of the band is done with a pair of contouring pliers, and the edge turned in too much at the occlusal end, when the cusp is in place, the point of contact will be below where it is united to the band, leaving a groove extending around the whole crown at the point of union of the cusp, giving the crown something of a door-knob effect (Fig. 252).

After the occlusal end of the band has been straightened as described above, it is shaped so as to bring out the normal contour

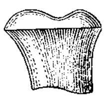


Fig. 251

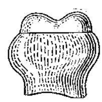


Fig. 252

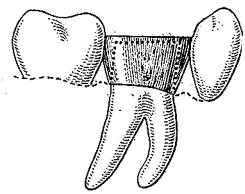


Fig. 253

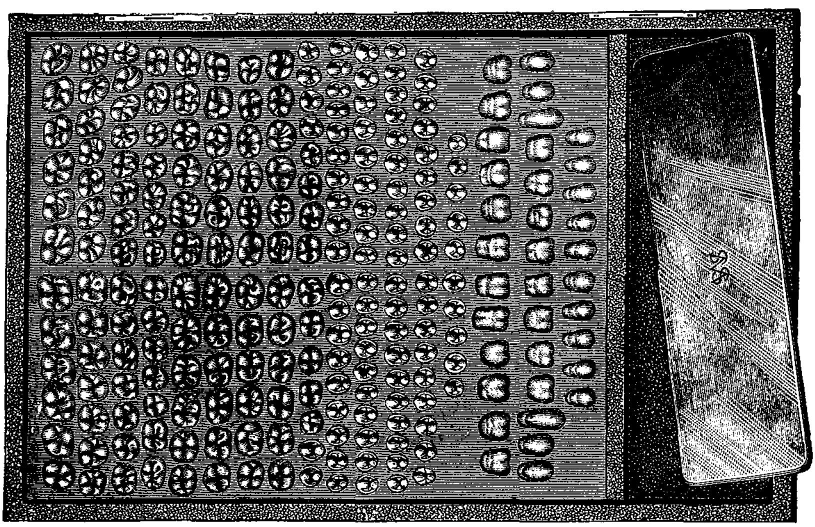


Fig. 254

of the tooth and to bring it in close contact with the adjoining teeth (Fig. 253). The occlusal end is filed perfectly flat and it is then ready for the cusp.

The Making of the Cusp.—There are many different methods of making the cusp, any one of which may be indicated in certain cases. One method is to carve the cusp in wax, modeling composition, or plaster. A fusible metal die and counter die is then made and a matrix of very thin pure gold, about three one-thousandths of an inch in thickness, is swaged from this and filled with coin gold or the trimmings from the band.

Another method is to have a supply of cusp buttons, similar to those used in the Hollingsworth system (Fig. 251). These buttons consist of a thin copper matrix filled in with soft solder. There are many good cusp buttons supplied with the Hollingsworth system, but they can be added to very easily by the dentist himself, as it is impossible to have too many of these buttons.

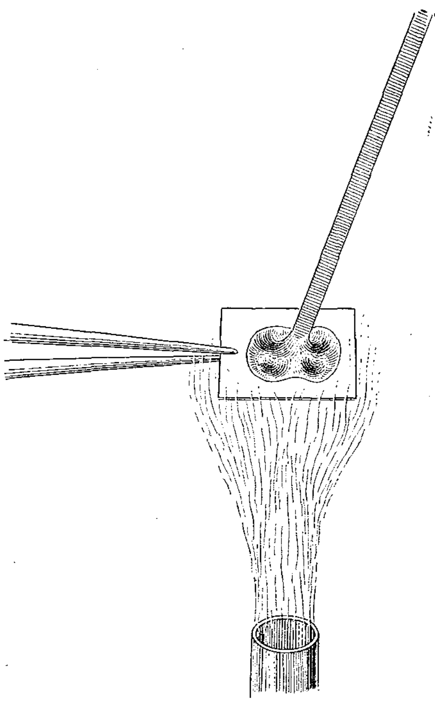


FIG. 255

In making cusp buttons an impression is taken, and a model prepared of any cusp which it is desired to reproduce, and a die and counter die made of fusible metal. The matrix is made of very thin brush copper, about No. 36-gauge, which can generally be obtained at an electrical supply house. This is well annealed and swaged between the die and counter die, carefully burnishing out any wrinkles which may appear.

It may be necessary to anneal the copper two or three times during the operations. After a perfect matrix has been obtained, it is thoroughly cleansed. This may be done by heating and dipping it in a 50 per cent. solution of alcohol and water. It is then fluxed with zinc chloride and filled in with tinner's half and half soft solder. This is very easily done by using the solder in the form of wire. The margin of the cusp matrix should be left until after it has been filled and the excess filed away.

FIG. 256

The cusp matrix is first fluxed with zinc chloride and then grasped with a pair of pliers and held over the flame of a Bunsen burner, and the wire solder fed in (Fig. 255), using enough so as to leave the surface slightly convex (Fig. 256), after which it is thoroughly cleansed with water to wash away the zinc chloride. Then the cusp button is laid on a very coarse flat file, grasped in

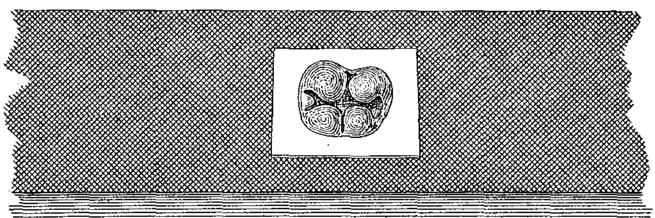


FIG. 257

the fingers, and rubbed back and forth, the extending surplus of the copper matrix protecting the fingers (Fig. 257), and the surplus solder is filed away until the under surface is perfectly flat.

After it is filed perfectly smooth and flat, the cusp button is completed by trimming and smoothing the edges (Fig. 258).

By having a large selection of these cusp buttons, one can generally be found which will so nearly fit the case in hand as to require but slight changes. It should be slightly larger than the band. If there are any points which need raising they can be built up with hard wax and suitably carved.

FIG. 258

A pure gold matrix for a gold cusp is made by using one of the swaging devices to be procured at any dental depot. They consist of a base with a raised anvil, a heavy metal tube passing over the anvil with a soft rubber plunger which fits into the tube and over this a metal plunger (Fig. 259). The pure gold used for the matrix is about three one-thousandths of an inch in thickness. This, when the gold is doubled, will fit into No. 34 Brown and Sharpe gauge. A piece of this pure gold, a little larger than the button, is

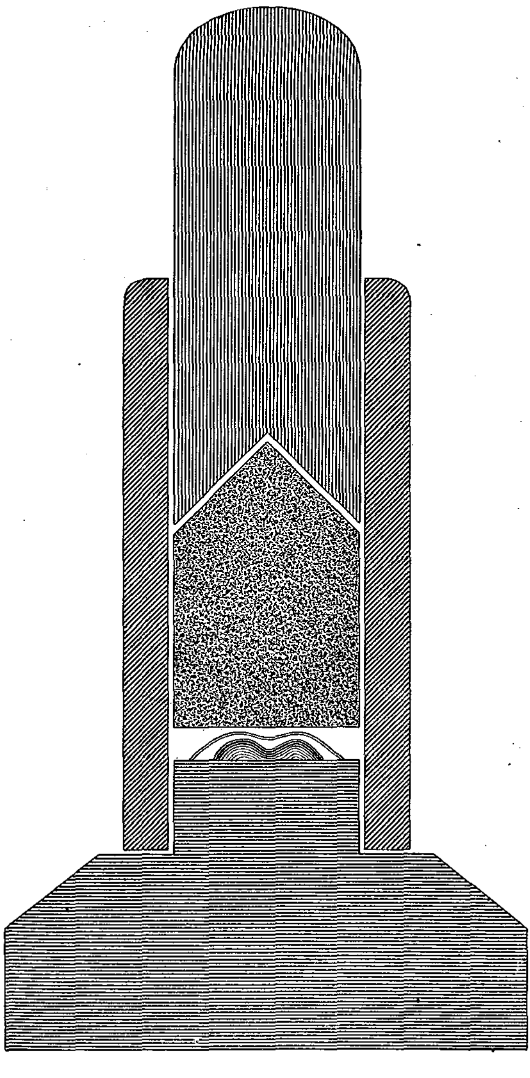


Fig. 259

annealed and pressed over the button as it lays on the anvil (Fig. 259). The metal cylinder is then put in place and the rubber dropped into it on top of the pure gold, and over this the steel plunger. The swager is then placed on a large anvil and the plunger is struck a sharp blow with a heavy hammer.[1] The

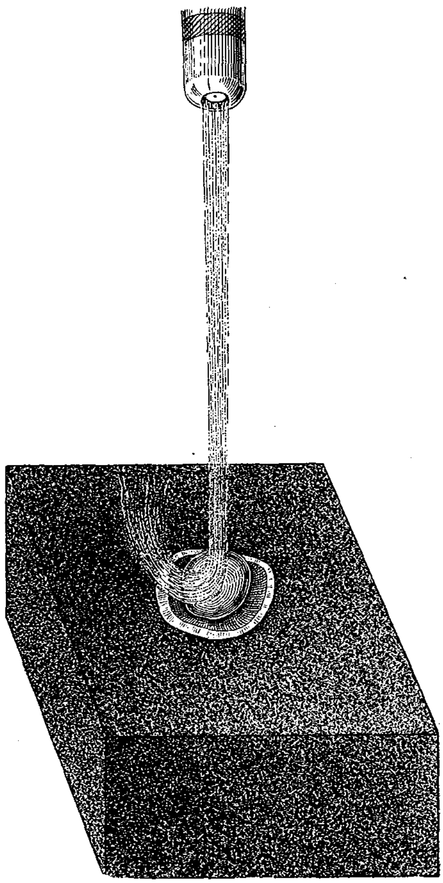


FIG. 260

matrix will be a perfect reproduction of the button which has been used. This matrix is now filled with coin gold.

Filling the Cusp Matrix.—The trimmings of the band and other scraps of coin gold are fused into a button sufficiently large

[1] A rawhide hammer, or a hammer having a fiber face is best, as it will not mar the plunger as does a steel hammer.

to fill the matrix. The matrix is placed on the charcoal block, cusp side down, and the heated ball of gold is placed in it and fused with the blow-pipe. This can be done by using a brush-flame, care being taken not to use more air than is necessary to keep the flame steady, holding the blow-pipe about two and one-half to three inches above the button of gold, using a steady pressure of air, just enough to carry the flame to the button and curl a little at the end, as in Fig. 260. The flame is flashed off for an instant, if the matrix becomes over-heated, and

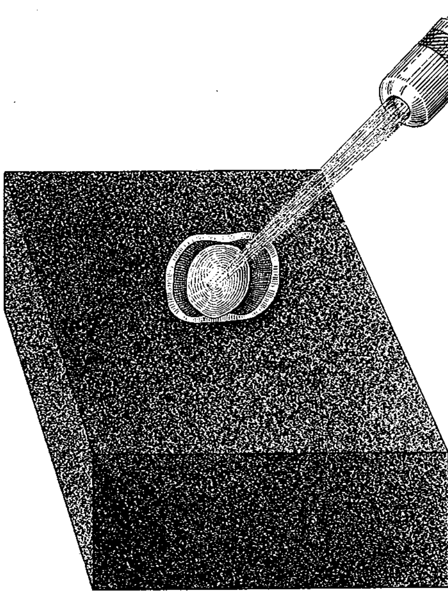


FIG. 261

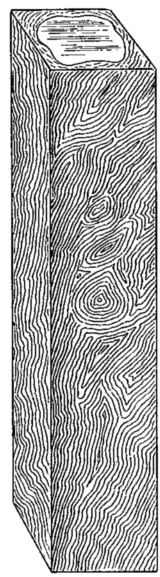


FIG. 262

then back again, repeating this as may be necessary until the gold is melted and fills the matrix. This slow soft flame will give sufficient heat to melt the coin gold, but not the pure gold matrix, which has a higher fusing point, unless it is held in one place for a long time.

To successfully fill a thin pure gold matrix with coin gold requires care, but a little careful practice with the blow-pipe will enable one to accomplish it with very little danger of burning. If too much air is used, it will give a hotter flame, and perhaps burn the matrix. The pure gold, being of a higher carat, with a slightly higher fusing point, will withstand a greater heat and allow the coin gold to melt and fill the matrix, provided the heat is concentrated upon the coin gold.

The cusp matrix can also be filled by keeping a small hot blue flame on the button of coin gold until it melts and fills the cusp (Fig. 261), but care must be exercised to keep it on the coin gold all the time, because if it should be moved a little to one side,

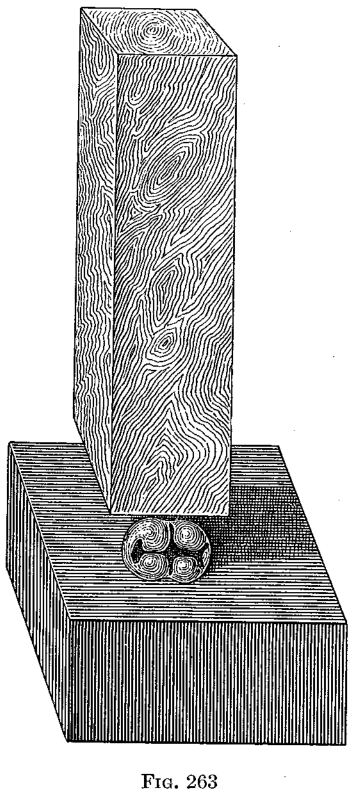


Fig. 263

so that the flame strikes the pure gold, it will be promptly burned as it is so very thin, and the flame so very hot. After it has been properly filled, it is cleansed and the under surface of the cusp is filed perfectly flat (Fig. 262).

In order to file this surface easily, the cusp should be held firmly. This can best be done by setting it in the end of a soft pine stick. The cusp is laid, flat side down, on an anvil, the end of the soft pine stick resting upon it, and the stick struck a sharp blow, with a mallet or hammer, thus driving the cusp into the wood (Fig. 263).

Another method is to heat the cusp red hot and place it on an end of the stick, cusp down and let it burn its way into the wood until it is nearly flush. Either method will hold the cusp firmly, so that it can be easily filed.

Uniting the Cusp to the Band.—After filing, the cusp is wired to the band in its proper position, the wire being brought over the cusp and across the gingival end of the band, and twisted in the center so as to draw and hold the cusp in contact with the edge of the band.

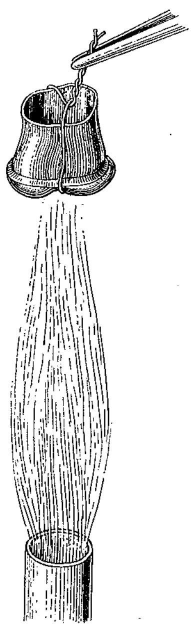


FIG. 264

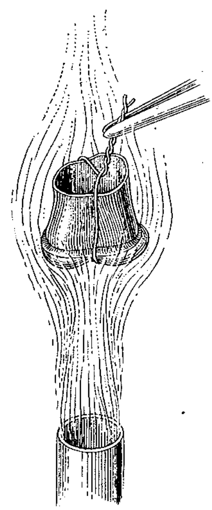


FIG. 265

Then the line of contact between the band and the cusp is well fluxed.

The twisted ends of the wire are grasped in a pair of pliers and the crown held over the tip of a Bunsen flame (Fig. 264). As the cusp becomes thoroughly heated and the gold almost reaches the fusing point, the crown is lowered slowly toward the center of the flame (Fig. 265). By watching it carefully a dark line appearing like flowing solder, will seem to flash around the cusp where it joins the band. This is the metal melting, and indicates that the cusp and the band are perfectly united.

As before stated, the crown should be held to the tip of the flame until the cusp has become thoroughly heated. If it is at once lowered into the flame, the cusp, being so thick and heavy, becomes heated very slowly, and the flame passing up around its sides would melt and ruin the lighter band before the cusp was hot enough to be sweated to it.

It should be remembered, that in sweating, the parts to be united should be brought to nearly the same degree of heat, otherwise one part will melt before the other, and there will be no union.

CHAPTER X.

THE MAKING OF THE CROWNS.

RICHMOND OR PORCELAIN-FACED CROWNS.

IN making a banded crown for any of the teeth in the anterior part of the mouth, the stump should be left standing from one-thirty-second to one-sixteenth of an inch out of the gum, until after the root has been trimmed and the band fitted.

After trimming, the measurement of the root is taken with a wire, straight across, at right angles to the long axis of the root (Fig. 266). It should not follow the festoon of the gum line, as that would carry the measuring wire lower on the buccal and lingual sides than on the mesial and distal, bringing it on a curve so that when the wire was straightened out it would be larger than the circumference of the root.

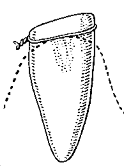


FIG. 266

The gold strip is cut, to measurement, with the ends parallel with each other so that when the band is made the sides will be parallel. One end is beveled and the lap made, and the band is sweated together and afterwards shaped and fitted to the stump, as in the case of the molar crowns already described.

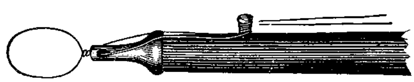


FIG. 267.—Kirk's dentimeter, suitable for taking the measurement of roots.

It should be carried well under the gum, especially on the labial side, being festooned carefully to follow the gum line (Fig. 268). After the band has been fitted it is removed and the root faced off, cutting well beneath the gum on the labial side so that the band will be entirely hidden. This ordinarily would be carried about one thirty-second of an inch below and at times even to a greater depth if the conditions are such to allow of its being done.

This work is accomplished with the root facers in the manner already described, after which the band is replaced on the stump and forced up as far as it will go. It is then scribed around on the inside, flush with the face of the stump, with a sharp instrument. The band is now removed and trimmed and filed to this line with

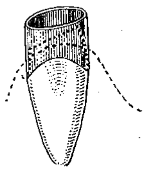


Fig. 268

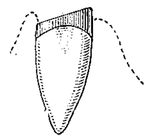


Fig. 269

a very fine flat file. The cutting and filing must be done very carefully, as the band, being narrow and frail, is easily bent out of shape. After filing, it is again tried on the root, so as to be sure that it has not become distorted, before sweating on the floor (Figs. 270 and 271).

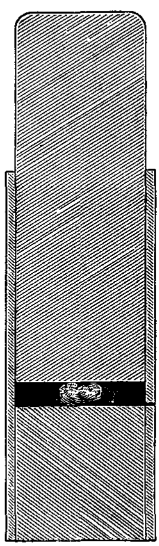


Fig. 270

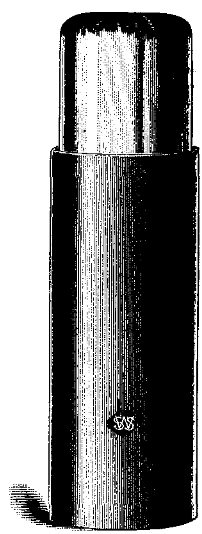


Fig. 271

It is not necessary that the band be wide on the labial side. In fact it is rarely that it should be more than one-thirty-second of an inch in width at this point. It is only necessary that it extend over far enough to get a good grip on the root, but great depth is not essential, as the greatest strength of the band is at the point nearest to the floor.

The band being properly filed, a piece of coin gold, No. 30 gauge, is prepared about one-sixteenth of an inch larger than the band. This is made perfectly flat. A little swaging device is used for this purpose, consisting of a steel anvil with a flat, smooth face, inserted in one end of a brass tube and having a steel plunger with a perfectly flat polished face which fits into the tube (Fig. 271).

The metal for the floor is annealed and then placed on the center of the anvil at the bottom of the tube. The steel plunger is then inserted into the tube over the gold and tapped with a hammer until the metal is perfectly flat.

The gold is then cleansed in acid. The band is now placed on this piece of gold so that it extends about an even distance from the edges all around. It is fluxed, one corner of the floor grasped in a pair of pliers and held in the Bunsen flame until it is sweated. The band and floor being of about the same thickness, it should be held near the middle of the flame, so that the flame will spread and come up around and over the cap, heating both the band and the floor equally (Fig. 272).

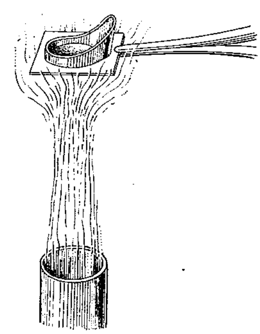


Fig. 272

As the piece is held in the flame, the edges of the floor will begin to melt and curl up slightly, just as the floor and band reach the fusing point. When this is seen it is removed from the flame. It will generally be found that at the corner where the floor was grasped by the pliers, the band and floor have not been united, owing to the pliers drawing the heat from the gold at this point. The floor is again caught by the opposite corner and held in the flame until the two parts are thoroughly united all around. The surplus metal of the floor is now trimmed flush with the side of the band. It is then ready for the pin.

Where to Drill the Hole in the Floor of the Cap for the Pin.—There are several ways of locating the point at which to drill the hole for the pin in the floor of the cap. Some operators use wax on the under side of the cap and press the cap on the root, the position of the hole is thus marked on the wax. Others, place in the root a short post with a sharpened end projecting just above the face of the root, so that when the cap is forced in place it will make a mark over the opening. But such methods are not necessary and take up valuable time.

In the six anterior teeth the canals are exactly in the center of the root. In enlarging the canal for a post for a Richmond crown, after having followed the canal, the reamer is partly withdrawn and the canal given a lingual slope, cutting it in that direction about the width of the pin lingually from the original line of the enlarged canal (Fig. 273). In making the hole in the floor of the cap, first locate the center of the floor and then drill, or punch the hole in the floor just the width of the post lingually (Fig. 274), and then by giving the post a slight bend, to follow the canal, it will pass through the floor, far enough from the buccal side to allow of plenty of room for the facing. This will apply to any of the six anterior teeth. When making a porcelain crown, the hole is

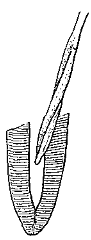


Fig. 273

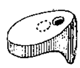


Fig. 274

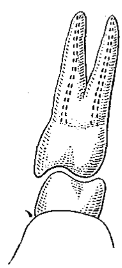


Fig. 275

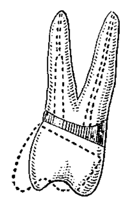


Fig. 276

drilled exactly in the center of the floor and we know of a certainty that the post will be in its proper position.

The pin for a first bicuspid crown, should always be placed in the lingual root. Unless the stump has been broken or decayed far below the gum so as to make the two roots very short, there is no necessity for using more than a single pin. The force exerted on these teeth is always upward and outward, there being practically no stress at all in the lingual direction (Fig. 275). If a single pin were placed in the buccal canal, the force being outward and upward, it would tend to loosen the crown from the lingual side, perhaps enough so that the edge of the band would clear the root at this point, with the result that the crown would be forced outward, and would almost certainly fracture the buccal side of the root (Fig. 276).

If the post be placed in the lingual root, the cap is bound down tightly at that point, and there is but little risk of its being forced outward, or being loosened from the buccal side, as the force of mastication will keep it pressed tightly against that face of the root (Fig. 277).

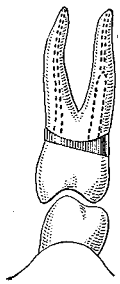


FIG. 277

FIG. 278

FIG. 279

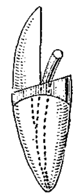


FIG. 280

In order to locate the opening in which to place the pin in these roots, follow out the lingual curve to a complete circle on the floor of the cap, and drill the hole exactly in the center of this circle. The pin will then enter the canal freely (Fig. 278).

The second bicuspid, has but a single root, but this is broad and flat, and there is more leeway than in the first bicuspid. In this case drill the hole a little lingually from the center, having enlarged the canal along this same line. It will also give more room in which to place the pin, as the root is somewhat constricted in the center (Fig. 279).

In grinding the facings for the Richmond crowns, it is better that they should be ground flat to fit the floor of the cap (Fig. 280), especially in the six anterior teeth where there is a likelihood of the gold being seen from the front if the facings are beveled so

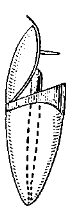


FIG. 281

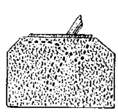


FIG. 282

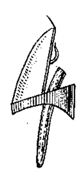


FIG. 283

as to just come in contact with the floor only at the labial side (Fig. 281). With the bicuspids there is not the same likelihood of the gold being visible between the necks of the teeth, so there is no objection to beveling the lower part of the facing, if it is desired.

The hole in the floor having been located and drilled, the cap is placed on the root and the pin put in position, carrying it as far down the canal as possible, waxed in place, removed, invested and soldered (Fig. 282). These pins are preferably made of round platinized gold clasp wire, and should be of about No. 14 to 16 gauge, the size of the pin depending on the tooth which is to be crowned.

Backing and Soldering.—The backings for these teeth are preferably made of soft platinum about three or four one-thousandths of an inch in thickness. Crown metal plate which has one surface of gold and the other of platinum may also be used. If it is desired to lighten the shade of the tooth, the gold side is placed next to the facing. The backings should fit the facing closely and extend from the lower edge of the lingual side of the facing to about one-sixteenth of an inch beyond the incisal edge, as in Fig. 283. The pins are flattened and then bent upward toward the incisal edge and against the backing, thus holding it close to the facing. The pin roughing and bending pliers are used for this purpose and are shown in Fig. 284.

Fig. 285 shows a small wax spatula especially adapted for light work of this kind.

The facing is waxed in position on the cap with sticky wax. After it has chilled, it will be found that the contraction of the wax on cooling has tilted the facing slightly so that it rides on the cap on the lingual side of the ground portion of the facing raising its labial side clear from the floor of the cap (Fig. 286). If it were soldered without remedying this defect, the facing would be still further drawn from the floor on the labial side, due to the contraction of the solder, leaving a V-shaped space between the facing and the floor of the cap.

To overcome this difficulty, after the facing has been waxed, it should be pressed outward at the incisal edge until the labial side presses on the floor of the cap, and the lingual side is just clear of it, so that if it is held up to the light, it can be seen that it is not in actual contact at that point (Fig. 287). If this has been done, when the crown is soldered, the contraction of the metal will draw the facing close to the floor on the lingual side, without disturbing its contact on the labial side, thus making a perfect joint.

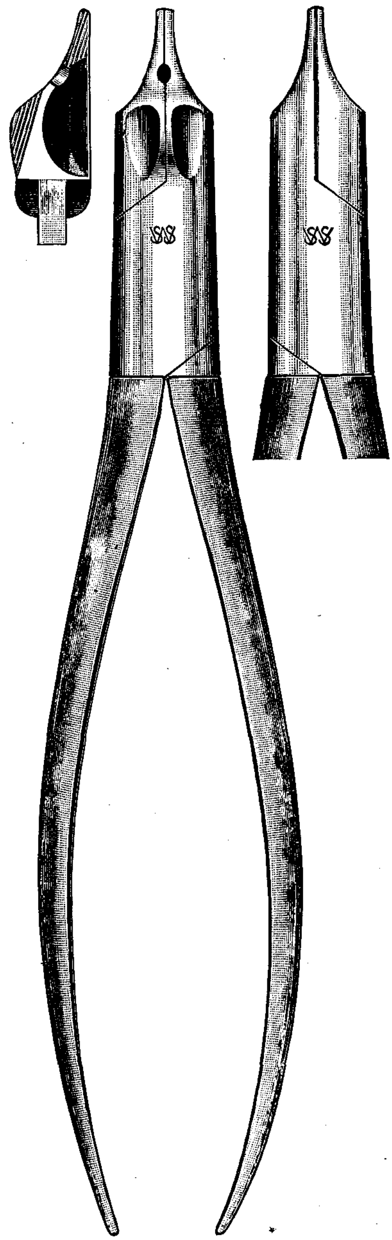


FIG. 284

The investment should be only large enough to hold the parts in position (Fig. 288). A small amount of the investment is placed on the slab and smoothed, as in soldering a porcelain crown. The inside of the cap is filled with investment and laid face down on

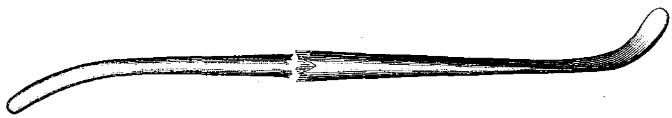


FIG. 285

the investment which has been placed on the slab and settled in place until the lingual side of the facing is exactly flush. The pin is covered with investment and the extending backing on the incisal edge is also covered, bringing it flush with the lingual side of the facing, as in Fig. 289.

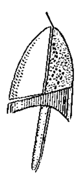


FIG. 286

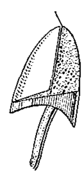


FIG. 287

After the investment has hardened, it is warmed slightly and the wax removed, after which it is heated thoroughly, and soldered. No more solder should be used than is necessary to restore the normal contour of the tooth, but the incisal edge should be covered thickly. After it has cooled, it is removed from the investment, cleansed in acid and finished.

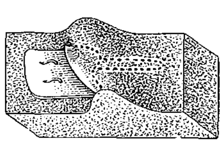


FIG. 288

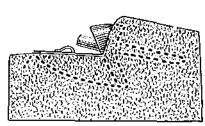


FIG. 289

The gold at the incisal edge should be left as thick as the bite will permit, in order to protect the facing, and it should be ground so as to leave it a little higher on the lingual side, but not enough so that it can be seen (Fig. 290).

The normal shape of the tooth should be restored as nearly as possible. The lingual surface of the incisors should be made concave from the incisal edge for about half the length of the crown (Fig. 291), and not convex as is so frequently done (Fig. 292).

The Richmond or pin crowns, and shell crowns are the principal attachments used in fixed bridge-work.

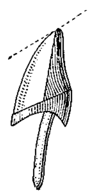


FIG. 290

FIG. 291

FIG. 292

PORCELAIN CROWNS (DOWNEY CROWNS).

In making a so-called Downey crown for any of the six anterior teeth, where a facing is used, and the lingual side built up with porcelain, the root is given a double slope in the manner already described, cutting well beneath the gum labially and carrying it just about to the gum on the palatal side (Fig. 293).

The cap is made of iridio-platinum plate, No. 32 gauge, and in the same manner as the cap of a Richmond crown, with the ex-

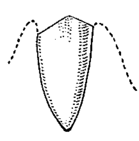


FIG. 293

FIG. 294

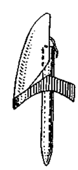


FIG. 295

ception of its being soldered with pure gold and having a double slope (Fig. 294).

The pin is placed exactly in the center of the cap, and the facing ground so that the gingival end touches the floor lightly at the labial side only (Fig. 295). This will allow of the porcelain body being worked under the facing more readily than if the facing had a broad contact with the floor. The facing may be grooved out between the pins to permit of the post setting well into the facing (Fig.

296), allowing plenty of room on the palatal side for the porcelain body. The two pins may be notched slightly with the edge of a small half-round file (Fig. 297) toward the incisal end to allow of their being bent flat against the facing, and bring them in contact with the sides of the post (Fig. 295). They should not be bent out and around the post, as this would frequently carry them so far lingually as to show through the porcelain, and consequently weakening the crowns.

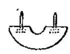


Fig. 296

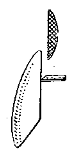


Fig. 297

After the pins are bent in contact with the sides of the post, they are waxed firmly with hard sticky wax. A small amount of wax should be flowed around the labial edge of the band between it and the facing to prevent any of the investment material from working in between the facing of the cap.

In investing this, for soldering the pins to the post, a small amount of investment is placed on the slab and smoothed off perfectly flat, leaving it from about three-eighths to one-half an inch in

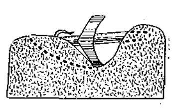


Fig. 298

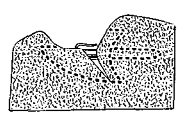


Fig. 299

thickness. The crown is then laid face down on the investment and pressed lightly until it is imbedded even, or flush, with the lingual side of the facing. A little of the investment is then placed over the end of the pin to hold it in position (Fig. 298).

No investment should be placed inside of the cap. This should be kept perfectly clear, the bulk of the pin and the cap being exposed to the flame. If the cap is filled with investment material, and the post and cap thoroughly covered, as in the illustration (Fig. 299), it will require a greater length of time, and much more heat to unite the pins to the post, as there would then be such a large mass of investment to heat up. The investment taking the heat from the post, would make it very difficult to get it hot enough to solder the pins of the facing to it with pure gold. On the other hand, if the cap and the larger part of the post is left exposed, as soon as the investment is heated up to a red heat, by throwing the flame on the metal parts, the pure gold will quickly flow in between the pins and the post.

The flame of the blowpipe should never be thrown on the metal parts until after the investment and facing are thoroughly heated to a bright red heat, otherwise the facing will be broken, owing to the sudden expansion of the platinum pins. After it has been soldered, it is cleansed in acid and is ready for the application of the porcelain body.

HALF CAPS OR WINDOW CROWNS.

The half cap, or window crown, was at one time used quite extensively as an anchorage for bridges. It was very unsightly and was a very poor attachment to say the least, and while at the present time there are some who still use it, it is becoming obsolete, so that it would be a waste of time to go into a description of its construction.

JACKET CROWNS.

The jacket crowns are designed to be used where it is desirable to avoid devitalizing a tooth. They are indicated when it is necessary to crown peg-shaped laterals or undeveloped teeth of a similar character, where the crowns are very small, or where the crowns of teeth are much decayed, and the pulps have receded (Fig. 300).

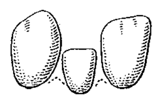


FIG. 300

The method of making these crowns varies according to conditions to be met, and the materials used in their construction.

Where the crowns are needed for much decayed anterior teeth, the labial face of the tooth is ground away as much as possible without endangering the life of the pulp, cutting well under the gum, as in Fig. 301. The enamel is also removed from the sides and palatal portion so that the band will hug the root tightly under the gum. The band is then made and fitted to the stump and cut out on the labial side flush with the tooth (Fig. 302). The palatal side of the band is pressed in close to the stump and the mesial and distal sides of the band spread out nearly to the width of the facing which is to be used, and a floor of coin gold sweated or soldered to it (Fig. 303). A thin facing is then ground so as to leave a little space between it and the cap, touching the latter only at the gingival end

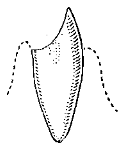


FIG. 301

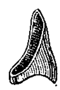


FIG. 302

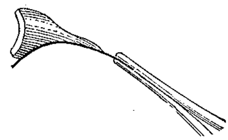


FIG. 303

(Fig. 304). The facing is now backed with thin platinum or crown metal, which is allowed to extend about one-sixteenth of an inch beyond the incisal edge. It is then waxed to the cap, invested and soldered, flowing the solder between the facing and the cap and if necessary over the palatal portion of the band (Fig. 304).

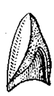


FIG. 304

FIG. 305

Another method of making the jacket crown is to carry the band to the full height of the tooth, to contour it, and cut it out on the face to the depth of the facing. The facing is then ground to fit the edge of the cap so formed and a backing of coin gold fitted carefully to it (Fig. 305). This backing with the facing in position, is then adjusted to the cap, waxed, the facing removed and the backing sweated, or soldered to the cap with 22 carat solder (Fig. 306). The facing is then put in place, the pins waxed on the inside of the cap, and the crown invested. The crown is invested face down and covered but lightly, leaving the opening fully exposed,

FIG. 306

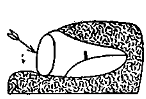


FIG. 307

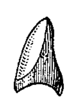


FIG. 308

as in Fig. 307. It is thoroughly dried out and flux placed on and around the pins. A piece of 18 or 20 carat solder is then placed over the pins, the whole brought to a brigth-red heat, and with the fine blue point of the blow-pipe flame thrown on the inside, the solder is melted, uniting the facing to the cap. Fig. 308 shows the completed crown.

In making a porcelain-faced crown for a bicuspid having a vital pulp, the tooth is prepared in the same way as for an anterior tooth, cutting it well out on the buccal side, and grinding away the inner cusp (Fig. 309). The band is then made as for a full gold crown, and cut even with the cusp at the top and enough on the buccal side to allow for the facing (Fig. 310). The facing is then ground to fit the edges of the cap (Fig. 311), and a backing of coin gold fitted to it. The backing being fitted to the facing, it is placed in position on the cap and waxed and soldered with 22-carat solder. The backing is then cut off even with the rest of the band and filed flat (Fig. 312). The tip of the facing is then ground on a bevel with an angle of about 45°, the lower edge of the bevel being on a line with the top of the cap (Fig. 313).

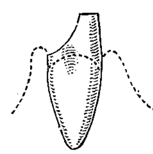


FIG. 309

A cusp is then selected, the under surface filed flat and the buccal side beveled to meet the bevel of the facing (Fig. 314). The cusp is then wired to the cap and soldered with 22-carat solder, the facing having first been removed. The cap is then cleansed in acid and the facing replaced in position and waxed. It is then invested and soldered from the inside as already described in Fig. 307. The jacket crowns described can be used as abutments in fixed bridge work.

Where it is desired that the crown should be of all porcelain, the cap should be made of soft platinum, No. 32 gauge, and fitted carefully to the stump all around. The facing is then ground

FIG. 310

FIG. 311

FIG. 312

FIG. 313

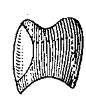


FIG. 314

in place and attached to the caps by means of the pins soldered to it with a very minute quantity of pure gold, after which the crown is completed by building up with porcelain.

THE CASTING PROCESS AND ITS AVAILABILITY IN CROWN WORK.

The introduction of the casting process opened up a large field in this branch of prosthesis, but it must be employed with a full recognition of its limitations. Cast gold is not as strong as rolled gold, and a bridge of cast gold is not as strong as one built up and soldered. The shrinkage of the metal in cooling must also be taken into account or failure on that score is sure to result.

The metal used for this work should be of a high carat, and of as great tensile strength and rigidity as possible. It should not be overheated. Coin gold appears to be well adapted for this purpose as it possesses the qualities above mentioned and gives a good sharp casting.

All Porcelain Crown with Cast Base.—This, being one of the simplest and easiest crowns to make, will be first considered. The root for a crown of this character requires little preparation, as compared with one for a Richmond or other banded crown. The face of the root may be irregular from decay or fracture, or it may have been ground down to meet the requirements of the case. In any event, it should be cut well beneath the gum line on the labial side, and on the lingual side enough to suit the requirements of occlusion. The lingual side should, if it is possible, be beveled so that the base will overlap, thus giving additional support to the crown, and at the same time, serving to strengthen the root and overcome the liability of fracture (Fig. 315).

The crowns used for this purpose may be any of the numerous varieties which are made by the different manufacturers, even to the diatoric teeth which are made for vulcanite work. The crown selected is ground to conform to the size and shape of the root, and to touch it only at the labial side, leaving plenty of room between the face of the root and the crown to allow of a heavy base, as in Fig. 316.

The post, or pin, which is preferably made of iridio-platinum or platinized gold wire, is then adjusted, and should be of sufficient length to go nearly or quite to the bottom of the hole in the base of the crown and into the root to a depth at least equal to the length of the crown (Fig. 316). It is well to first flow a little sticky wax around the post, between the base of the crown and the face of the root, at point *a* in Fig. 316, as the wax, of which the base is to be made, will adhere to the post better than it would otherwise.

The base of the crown should be moist or be lightly oiled or coated very thinly with cocoa-butter to prevent the wax from adhering to it, and the base wax, which should be a little softer and tougher than the ordinary inlay wax, is softened and pressed around the pin at the base of the crown, which is forced on the root and carefully adjusted in position. After the wax has been chilled, the surplus should be carefully trimmed, until it is perfectly smooth and flush with the sides of the crown and root (Fig. 317). The crown, together with the pin, is then removed from the root and the sprue wire attached, or it may be attached in the mouth as in Fig. 317, by heating it just sufficient to imbed it slightly in the wax. It may be more firmly fixed by flowing

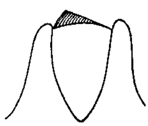


FIG. 315

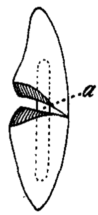


FIG. 316

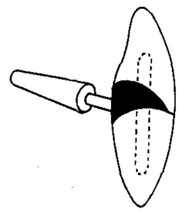


FIG. 317

a very small amount of wax around it at the point of entrance, after which the crown has been removed.

The sprue wire is now placed in the base of the flask (Fig. 318) and the crown base is invested in the same manner as an inlay, painting the investment on very carefully so that there may be no air bubbles, which would be reproduced in gold in the casting and interfere with the fit of the base. After casting, it is cleansed

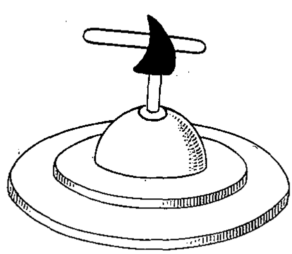


FIG. 318

and polished and adjusted to the crown and root. The base is first cemented to the crown and after the cement has thoroughly hardened, it is cemented in the mouth.

This makes a satisfactory crown when used singly, but it is not suitable for a bridge, as all bridge abutments should be banded.

Banded Crowns.—The caps for these crowns can be made in the same manner as for a Richmond crown, being carried well beneath the gum labially. The impression is taken and the model prepared in the usual way.

The crown is ground in the manner already described in treating of a crown with a cast base, being beveled lingually and on the mesial and distal sides about half or two-thirds of the way to the labial face (Fig. 319). This allows a sort of a socket for the crown to set in, and, at the same time, insures the correct position of the crown on the base.

The base of the crown is lubricated, so that the wax will not stick to it, and the wax flowed in between the crown and the cap, until it is well filled, after which it is carved flush with the crown and the band and the sprue wire attached, as in Fig. 320. The crown is now removed, leaving a wax base attached, as in Fig. 321. It is then set in the flask base and invested and cast in the usual manner. The base should be polished with the crown in position,

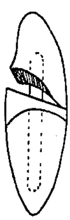


Fig. 319

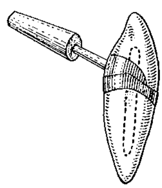


Fig. 320

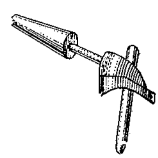


Fig. 321

after which the crown is cemented to the base and kept under pressure until the cement has hardened. It will then be ready for the mouth.

This method of procedure may be followed in making any crown of this type from molars to incisors.

Casting Base for Crown with Porcelain Facings.—In crowns of the Richmond type, where a porcelain facing is used, the cap and pin are made and fitted to the root, and the facing ground to place sloping it slightly more than the floor, so as to allow the wax to flow under the facing (Fig. 322). If there has been much recession of the gum, so that the band has to be sloped greatly labially (Fig. 323), it is well to grind a step in the bottom of the facing, in order that there may be a good base for it to rest on, thereby rendering it less liable to be forced down the incline and fractured (Figs. 323 and 324). The facing should then be lubricated on the lingual side, and held in place with a little sticky wax on the labial side, or a light wall of plaster or modeling composition. The lingual side should be built up with hard inlay wax and carefully carved and smoothed (Fig. 325). It should be remembered that the more carefully the crown is finished in the wax, the easier it will be to finish the completed crown.

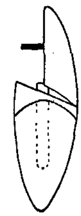


Fig. 322

The sprue wire is attached, as shown in Fig. 325 the facing carefully removed and small pins of graphite inserted in the holes left by the tooth-pins, leaving them long so as to be gripped in the investment (Fig. 326).

Another method is to enlarge the pin-holes in the wax after removing the facings and dovetail them on the inside, as in Figs. 327 and 328. This can be readily done with a small coarse bur. It is then invested, care being taken to fill with the investment if the pin-holes have been enlarged.

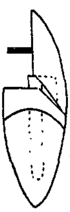


Fig. 323

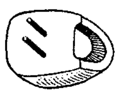


Fig. 324

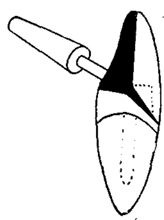


Fig. 325

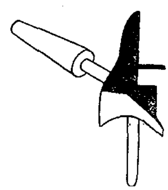


Fig. 326

If graphite pins have been used, after the casting has been made, they are removed, the sides of the holes roughened, and the piece cleansed and polished. The tooth-pins are then lightly threaded

Fig. 327

Fig. 328

Fig. 329

or roughened and the facing cemented in place. If the holes were enlarged and dovetailed, the pins may be flattened a little and then bent at right angles, as shown in Fig. 329, and cemented in place.

Casting Directly on the Facings.—In making a single crown or a small bridge, where it is intended to cast directly against the facings, great care should be taken that the wax does not overlap the porcelain at any point. This is of the utmost importance, for should the wax be extended so as to grip the facings when the casting is made, the contraction of the metal on cooling will be certain to crush them. The wax should be carefully trimmed to the edges of the porcelain, and it is a good plan to clean them well by rubbing the edges with a piece of tape or cloth before investing.

Drying out and Heating up the Flask.—The flask should be dried out carefully and then brought to a very high heat throughout so that the facing will be red hot when the gold comes in contact with it. If the facing is cold, or but slightly heated, when the casting takes place, the rapid expansion of the platinum pins, taking the heat so much more quickly than does the porcelain, will fracture the facing. After casting, the flask should be allowed to become cold before opening, after which the piece is cleansed and is ready for finishing.

The crown, or the bridge, which has been made in this way will be satisfactory, providing there is little or no strain on the facings, but otherwise the method is decidedly objectionable.

In a facing which is reheated, in soldering or otherwise, the strength of the porcelain is diminished, and especially is this the case if a mass of gold is forced upon it in a molten state. The piece may come out with the facings seemingly intact, but they have been weakened and in the majority of cases, if examined under a microscope, will show innumerable fine checks running all through them. If it is possible to avoid it, it is far better not to subject the facings to this refiring, as they are thereby rendered much less serviceable than they otherwise would be.

CHAPTER XI.

BRIDGE-WORK.

A DENTAL bridge consists of a continuous masticating surface, or of a succession of crowns or dummies having incisal edges. As its name implies, it is a bridge proper, depending for its retention and support upon the natural teeth or roots in the mouth, which serve as abutments. The success and the permanence of the device, in this, as in the case of any other form of a bridge, depends entirely upon the number, position and condition of the abutments.

The primary object of bridge-work has been, and is, to do away with the inconveniences associated with a plate, and to give patients an appliance which through its firmness and immobility will enable them to perform the masticatory function more perfectly than can possibly be done with a plate.

The natural teeth or roots supporting a bridge are called the abutments, and the intervening portions are known as the body of the bridge. The body of the bridge is made up of one or more pieces representing the different teeth and these are known as dummies.

The idea of bridge-work is not new. We fine many traces, even among the ancients, of attempts to restore lost teeth. These early efforts were confined almost exclusively to fastening together with wire the crowns of natural teeth, and these in turn were bound to the remaining teeth in the mouth by wires. These restorations were entirely for esthetic purposes, and were of no practical value to the wearer for mastication.

Modern bridge-work is of comparatively recent date, and it is only within the past thirty or thirty-five years that it has been put to really practical use, and today it is recognized as being an important specialty of the dental profession. There is no form of denture made which so nearly approaches nature in the restoration of the normal function of the lost organs.

CLASSIFICATION OF BRIDGES.

Dental bridges are divided into two primary classes, fixed and removable.

Fixed bridges are those which are attached to the abutments so that it is impossible for the patient to remove them, or even the dentist, without more or less mutilation of the abutment crowns.

Removable bridges are those which can be removed from the mouth by the patient for cleansing or other purposes, without interfering with or disturbing the stability or integrity of the appliance.

The insertion of dental bridge-work requires the mutilation of the teeth, serving as abutments, to a greater or less extent, and in nearly every case the pulp must be sacrificed. This was at first considered as one of the great objections to bridge-work, but it was simply a case of sacrificing one for the good of many. If the work was properly done, it was found that this sacrifice was justified in the increased comfort and improved health of the patient.

The value of bridge-work is unquestionable. This value depends entirely upon the manner in which the work is done, and where it is used and not abused, there is nothing that can take its place.

Bridge-work is not universal in its application, and is not intended to do away with other forms of denture, but it is unquestionable that in a large number of cases where partial plates are being placed in the mouth, that they are in reality an injury, rather than a benefit of the patient, and bridge-work is positively indicated and would render far greater service than is possible with the dentures, which are given them.

REQUISITES OF A DENTAL BRIDGE.

The first requisite of a dental bridge is that it should restore as nearly as possible the lost functions and appearance of the teeth which have been lost. Esthetic conditions are too frequently lost sight of in this work, but they are as important in this as in any prosthetic operation, and as much attention should be paid to esthetic effect as can be safely done without sacrificing the utility of the piece.

The crowns or facings which are to be used should be carefully selected, with due regard to their proper sizes, shapes, texture and colors. The occlusal surfaces should be made so that they shall effectively perform the work of mastication, and at the same time with no undue strain on the abutments.

Every portion of the bridge should be made with the idea of accessibility to the bristles of the toothbrush in cleansing, so that it may be kept as free as possible from foodstuffs and other debris. Spaces between the facings themselves, or between the facings and the abutments in bridges restoring teeth in the posterior part of the mouth should be partially filled with gold so as to offer as little lodgment for foreign substances as possible. Unnecessary exposure of gold is always to be avoided, and never in any bridge, placed anterior to the bicuspids, should gold be shown.

THE PREPARATION OF ABUTMENTS.

The first and most important consideration in preparing for the insertion of a bridge is the condition of the abutments. The directions given in Chapters IV–VI on the treatment and the preparation

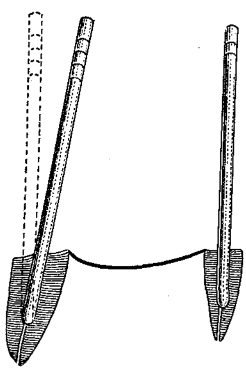


Fig. 330

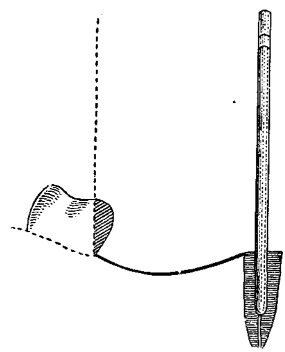


Fig. 331

of the roots and the perfect adaptation of the bands to the stump or roots will apply with far greater force when these roots are to serve as abutments for a bridge.

Paralleling the Abutments.—Regarding the mutual relation of the individual abutments, they must be made parallel, or very nearly so, especially where there are more than two. As previously stated, there is a slight natural movement to the roots of which advantage can be taken to help hold the bridge firmly in position, and the abutments may be very slightly converging or diverging, so that there will necessarily be a slight spring to them in placing the bridge in the mouth; but this movement must be very slight, otherwise it would result in the loosening of the teeth.

In paralleling a series of abutments, the start should always be made with the smallest and the others paralleled to that one, especially if this small abutment is an anterior root in which a pin or tube is to be used. The object of doing this can readily be seen by studying the illustration. If one of the abutments is a lateral incisor and another a cuspid or a tooth on which is to be placed a shell or telescope crown, the lateral being a very small root allows very little leaway in placing the post or tube, as the canal must necessarily be enlarged on its original line. If a cuspid is used as another anchorage, the root is of sufficient size so that the canal can easily be sloped to one side or another to make it parallel with the lateral abutment, as shown in Fig. 330. Should one of the other abutments be a shell crown, the stump can readily be ground on one side or another to make it parallel with the lateral or bicuspid abutment (Fig. 331).

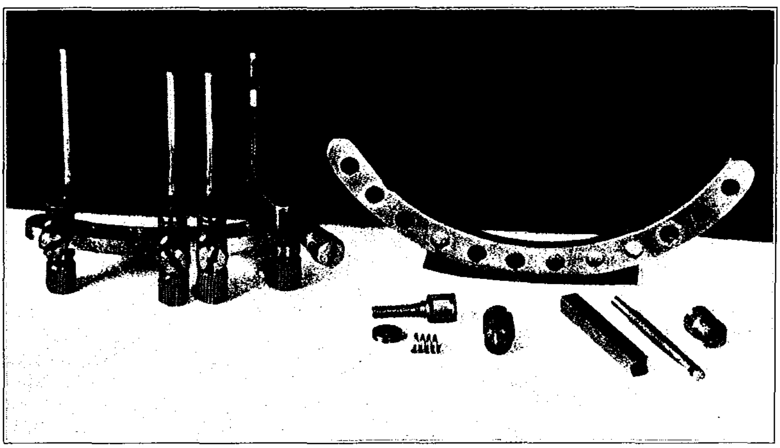


Fig. 332

THE WEINSTEIN PARALLELING DEVICE.

Mr. L. J. Weinstein's paralleling device is essentially practical. The mechanical construction is very simple and it combines ease of manipulation with perfect accuracy. Its range of adaptability is far greater than anything else available up to the present time. The device consists of an arch of steel, perforated at intervals as shown in the illustration (Fig. 332). In these holes are fitted studs, held in place with collar, and nut with spring giving constant tension. Through the square opening in the top of this stud is passed a hollow square bar with a V cut in one end. Through this bar is passed a round rod with a hole in one end to receive the mandrel, the other end being threaded to receive a knurled nut.

The mandrel is placed in the hole in the rod and the nut tightened, drawing it into the Veed end of the hollow bar and holding it perfectly rigid.

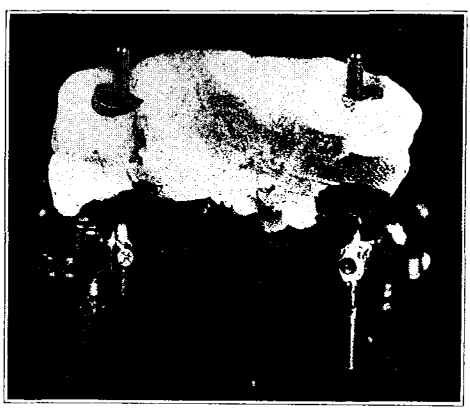


FIG. 333

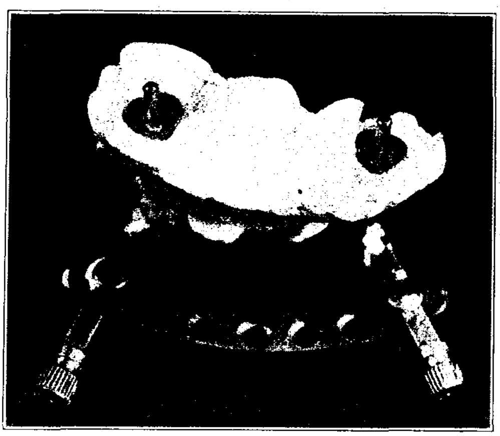


FIG. 334

This bar can be moved horizontally in any direction and locked in place by tightening the nut on the stud on the underside of the arch. The device will accommodate any required number of the mandrel holding rods and several abutments can be paralleled simultaneously. The caps can be placed on the roots, the tubes on the mandrels and after entering them in the canals they can be waxed to the caps, removed and soldered.

Another method is, after placing the tubes in position, to take an impression, covering the ridge, caps and mandrels with plaster. After the plaster has hardened, the impression is removed from the mouth, with the caps and tubes in place, as shown in Figs. 333 and 334. The impression is removed from the paralleling device by loosening the nuts at the end of the square rods and withdrawing the mandrels from the holders. The caps and tubes are then waxed from the under side in the manner already described, the impression varnished and a model prepared, and the waxing

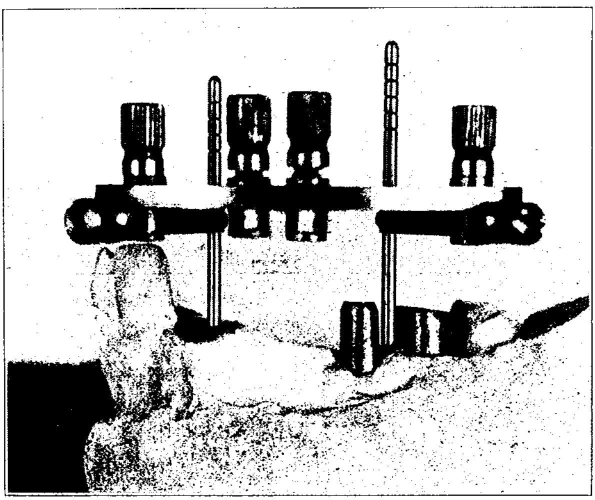


Fig. 335

of the tubes to the caps is done on this model. The caps and tubes are then removed, invested and soldered.

Fig. 335 shows the manner of paralleling posterior abutments to an anterior abutment, either in the mouth or on the model. The mandrel is fitted in the tube in cuspid root and locked to the arch. Another mandrel is locked tightly in a holder distally but the nut locking the bar to the arch is tightened only enough to hold the mandrel holder in proper position so as to allow of easy movement in a horizontal direction. The mandrel in the cuspid tube rotating freely, allows the other mandrel to move freely to any point so that the molar or bicuspid caps are easily adjusted.

The paralleling device outfit consists of two arches (small and large) and the necessary mandrel holders, a gauge for quickly measuring the diameter of mandrels or tubes and a number of *non-rusting* mandrels, one-half to one-thousandth of an inch smaller than the hardened steel mandrels over which the platinum tubes fit snugly. These mandrels are very useful as they will not rust from contact with saliva, or when being exposed to the air, and being just a trifle smaller, go in and out of the tubes easily, whereas, the hardened steel mandrels, over which the tubes are made or drawn, must, of necessity, fit quite snugly.

All the parts of the paralleling device are rust-proof so that it is not affected by moisture.

FIG. 336.—Upper and lower teeth in occlusion. (From photograph of specimen in the Wistar Institute of Anatomy.)

OCCLUSION.

In addition to its other requirement, the occlusion of a bridge piece must be as nearly perfect as it is possible to make it. This is a most important consideration and one to which too little attention is generally given. A bridge which properly occludes with the opposing teeth will not only be more effective than one faulty in this respect, but its use will be attended with far less liability of loosening or injuring of the abutments.

A large percentage of the cases of bridge-work are for the posterior part of the mouth, the dentist being most frequently called upon

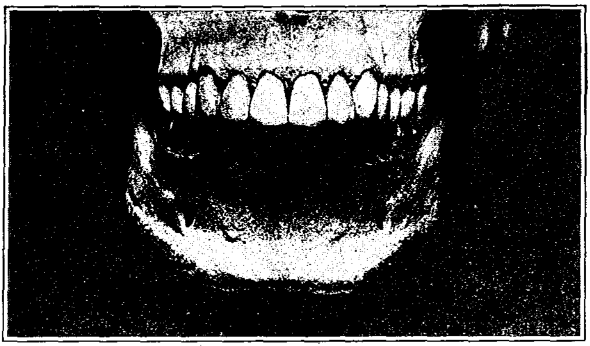


FIG. 337.—Occlusion of the incisor teeth. (From photograph of specimen No. 4237, Wistar Institute of Anatomy.)

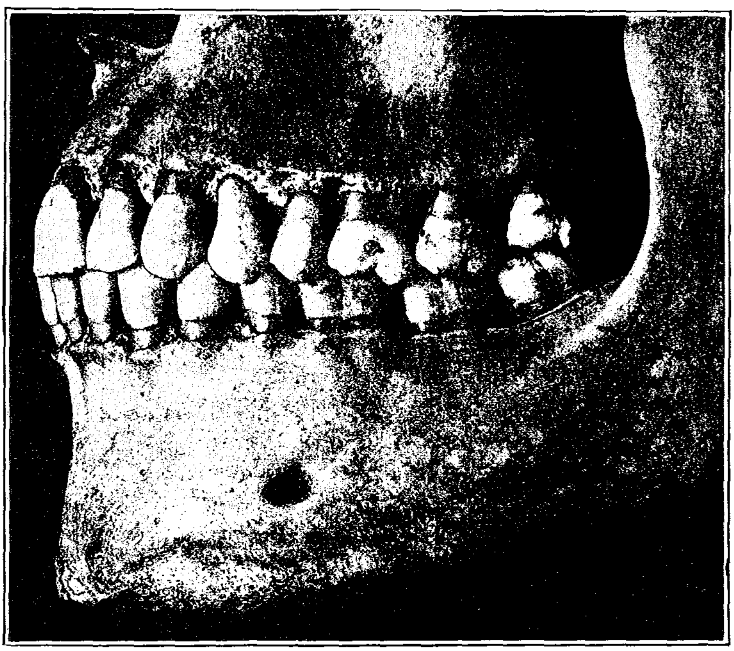


FIG. 338.—Occlusion of the molar and bicuspid teeth, external view. (From photograph of specimen in possession of the author.)

to restore lost molars and bicuspids. Where these teeth in either jaw have been lost for any length of time, their antagonists in the opposite jaw are sure to have elongated to a greater or less extent (Fig. 340), and if no measure is undertaken to prevent it, they will eventually be exfoliated. The normal line of occlusion must be

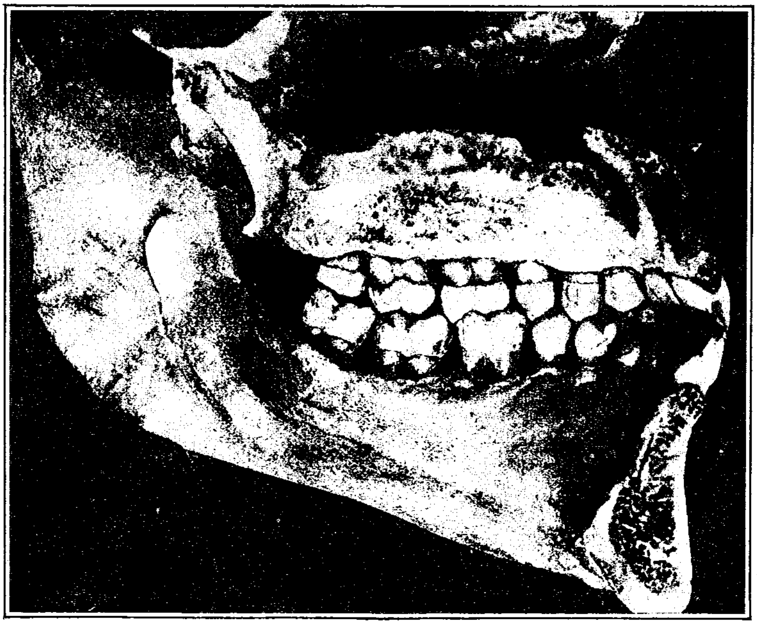


Fig. 339.—Occlusion of the molar and bicuspid teeth, internal view. (From photograph of specimen in possession of the author. Same specimen as Fig. 338.)

restored in such cases, if a satisfactory denture is to be made to replace the lost teeth, whether it be a plate or a bridge. If a bridge

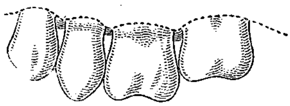


Fig. 340

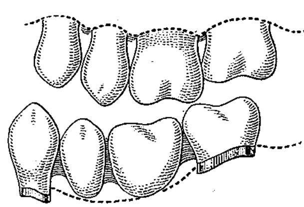


Fig. 341

is constructed without doing this, it can never be as serviceable to the patient as where the occlusion has been made normal. The triturating motion, so necessary for the perfect performance of the masticatory function, is interfered with or altogether lost, the only movements possible being the opening and closing of the jaws, in which case the food may be pressed or crushed, but not ground. The moment the mandible is thrust the least bit forward, the jaws are thrown apart and the only point of contact is the distal cusp of the elongated molar, with the mesial cusp of the lower molar opposite (Fig. 341).

Where this elongation of the teeth has taken place, they must be ground to the normal line of occlusion and the teeth carved so as to reproduce, as nearly as possible, the original cusps. If they have become very much elongated, it may be necessary to devitalize and crown them, or to restore their masticating surfaces by building up with gold or porcelain.

SELECTION OF FACINGS.

In choosing facings or crowns for a crown or a bridge, or in fact for any form of partial denture, the greatest care should be exercised to select those of proper mold and shade. If it is impossible to get a facing to match exactly, it is better that it should be slightly darker in shade rather than lighter than that of the natural teeth. If a crown is the least particle too light in color it is conspicuous, and is the first tooth seen when the patient opens the mouth, while if it is but slightly darker than the neighboring teeth it is not so noticeable.

In restoring the six anterior teeth, the facings should not be bought in sets as put up by the manufacturers. In the human mouth, these teeth are never all of the same shade. The central incisors have generally a yellowish cast. The laterals are of the same general shade but are clearer at the tip with a slight bluish tint, while the cuspids are the yellowest teeth in the mouth anterior to the molars. If the facings, restoring these teeth, are all of one color, they will not present a natural appearance, since their uniformity of color will at once advertise their artificial nature. They should be selected in pairs, the centrals, lateral and cuspids, each from a different set in accordance with the natural shading of these teeth, but the blending should be perfect.

As we go farther back in the mouth we find the bicuspids are more on the order of the lateral incisors, being clearer at the tips and of a slightly bluish tint, while the molars are generally yellow. In selecting these teeth, the bicuspids, especially the first, should be matched as nearly as possible. With the molars there is not the same necessity for being so exact. They should be of the same general shade and blend well, but may be darker than the natural teeth, but in no case should they be lighter.

The shapes of the teeth also should be studied carefully, and the form of those lost should be reproduced as nearly as possible by their substitutes. The types of teeth vary greatly, some having a broad flat face, others being very much rounded (Figs. 342 and 343). Again, it will be found that some are nearly flat from the

Fig. 342

Fig. 343

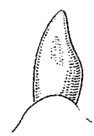


Fig. 344

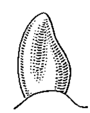


Fig. 345

incisal edge to the gingiva while others are decidedly convex, as in Figs. 344 and 345. Where one of these types prevail a corresponding tooth to replace it or its mate should always be selected.

The remaining natural teeth will serve as an index for the form of the selected crowns or facings.

FIXED BRIDGES.

In considering the construction of a fixed bridge, as a common type, one which might be called a skeleton bridge will be selected, one in which two full gold crowns or a full gold crown and a porcelain-faced crown are to serve as abutments, carrying one or more dummies, the occlusal and lingual surfaces being of gold, and using porcelain veneers simply for esthetic effect (Figs. 346 and 347).

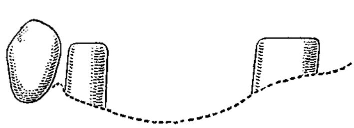


Fig. 346

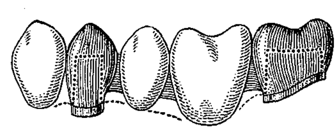


Fig. 347

The bands or caps having been adjusted in their respective positions in the mouth, the impression and articulation are taken, and the model is prepared in the manner already described. The shell crowns are completed and articulated and are then ready for the facings.

In selecting the facings for the case, it is desirable to choose them of such length that when they are ground into place, the necks will touch the gum lightly and the occlusal edges will be in contact with the antagonizing teeth (Fig. 348). They are ground to follow the gum line and should set very close to each other, but should not be in actual contact (Fig. 347). After they have been ground into place, a wall of plaster is built-up on the buccal side of the model, nearly to the occlusal or incisal ends of the facings, to retain them in position (Fig. 348).

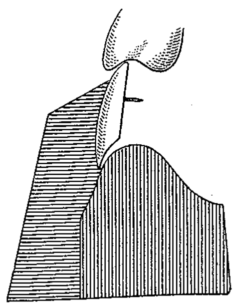


Fig. 348

Fig. 349

After the plaster has hardened, the facings are removed, and their occlusal ends ground off about one thirty-second of an inch and at an angle of about forty-five degrees with the back of the facing (Fig. 349). The line of their occlusal ends should be continuous, that is, the bevel of one facing should not be higher than another.

The facings are then backed, and for this purpose, platinum, crown metal or pure gold may be used. The gold will have a tendency to lighten the color of the facing and give it a slightly yellower

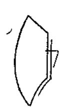


Fig. 350

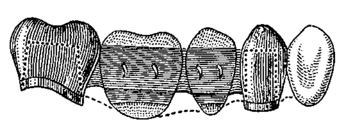


Fig. 351

cast, while the platinum will tend to darken it and confer a bluish tint. If the backing is of platinum or crown metal, it may be very thin, about three one-thousandths of an inch. It should extend from the inner edge of the bevel at the occlusal end, to about one-sixteenth of an inch beyond the lower edge where it has been ground to fit the gum (Fig. 350). The backing of each facing should touch or slightly overlap that of the one next adjoining and those of the end facings should be in contact with the abutment crowns (Fig. 351).

The pins are flattened with a pair of pin-roughing pliers, and are bent down over the backing, thus pressing it close to the facing. The facings are then waxed together and to the abutment crowns with hard adhesive wax, a piece of oiled-paper being placed under-

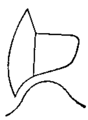


Fig. 352

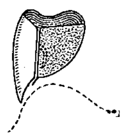


Fig. 353

neath on the surface of the cast to prevent the wax from adhering to it. The wax should be built up high enough to support the cusps for the dummies (Fig. 352). Suitable solid cusps are then made, ground or filed to fit the bevel of the facings, and fastened in place with adhesive wax (Fig. 353).

The bridge is now ready for investing and soldering. It is taken from the model, and the inside of the abutment pieces filled with the investing material and the whole bridge partly imbedded in it with the facings down. The investment should come over the backings which extend beyond the lower angle of the facings, holding them in place and preventing their springing up under heat (Fig. 354, *a*), and nearly to the lingual edge of the cusp (Fig. 354, *b*)

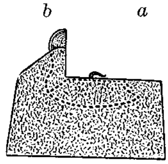


Fig. 354

Fig. 355

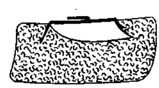


Fig. 356

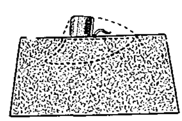


Fig. 357

and should be small, large enough only to hold the parts securely together. The abutment crowns are partly covered to protect them from the flame.

In grinding the facings of the dummies for any of the six anterior teeth, they should be made to set closely to the model, and after they are properly fitted a wall of plaster is made on the labial side.

The facings are then backed, the backings extending over the beveled portion at the neck and about one-sixteenth of an inch beyond the incisal edge and the pins flattened and bent toward this edge close to the backing (Fig. 355). In investing, the investment should cover the extending portions of the backing, both at the incisal and gingival ends, to prevent its warping (Fig. 356).

After investing, a wire of coin gold should be fitted to, and laid over, the backings at the gingival edge as shown in Fig. 357, so that in soldering, the lingual side may be built up more nearly to the normal contour of the tooth.

Bridges of three or four teeth may be soldered in one piece, but large cases should be soldered in sections, because the contraction of large masses of solder, when the piece is cooling, has the effect of disturbing the relation of the abutment pieces, and in consequence the fit of the bridge is impaired. A full bridge of twelve or fourteen teeth should be soldered in three or four sections. If in three, the incisors may be soldered in one piece, and the sides, from the cuspids back, separately. If in four sections, the central, lateral and cuspid of each side may be soldered separately, and also each side sections.

The different sections are finished and polished except where they are to be united. They are then replaced on the model, waxed together with adhesive wax, and a strong iron or brass wire bent to conform to the lingual side of the bridge and thoroughly waxed to the different parts. This will hold them firmly in their relative positions, and prevent their springing while being removed from the model and invested. The bridge is then invested, the divisions between the several sections being freely exposed and the parts united with the same, or a slightly lower carat solder than has been used in the previous soldering. When the investment has cooled, the bridge is removed, pickled in dilute sulphuric acid, and finished.

Interchangeable Facings.—In using interchangeable facings of the Steele or Evslin type (Figs. 354 and 355), the facings are ground in as are the ordinary pin-facings, and afterward a wall of plaster is built around them, reaching nearly to the incisal edges. The backings are then fitted and should be carried a little beyond the incisal edge. The backings should be made so that they will come in contact with each other, after which they are waxed firmly together with hard, sticky wax, a heavy iron or brass wire being laid across the lingual side of the backings to prevent their becoming distorted in removing the facings and investing.

After the facings are removed, it is well to give the labial side of the backings a coating of anti-flux (whiting may be used for this purpose) before investing. This will tend to prevent any solder from flowing on that side of the backings.

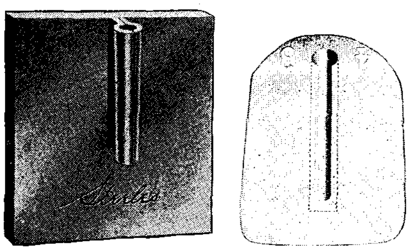


FIG. 358

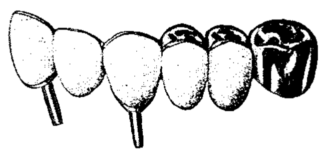


FIG. 359

They are then invested, labial face down, and should lay nearly level. After the wax has been removed a heavy gold wire, preferably square, should be fitted along the gingival edge of the backings, as in Fig. 360, and the piece heated up for soldering. Twenty or twenty-one carat solder should be used for soldering, and the solder built up so as to restore as nearly as possible the normal lingual surfaces of the teeth, leaving it thick at the incisal edge. It will be found that the wire across the base of the backings will very materially aid in giving form to the backs. The piece is then cleansed and finished.

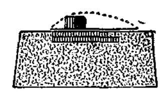


FIG. 360

In finishing a bridge of this character, it is well to outline and contour the lingual surfaces of each tooth restored so that they will resemble the lingual surfaces of the natural teeth as nearly as possible and present a more artistic effect, and consequently a much more comfortable feeling to the tongue.

In finishing the incisal edges of the backings, the facings should first be replaced and then the backings ground from the labial side flush with the facings at that point, and extending a little upward on the lingual side, as in Fig. 361, so that the backing will be a little longer at this point and will protect the facings. The gold should be left as thick as the bite will allow at the incisal edge so as to protect the facings and lessen the liability of their being broken. Such facings are much weaker than are the ordinary pin-facings, and for this reason, it is always best to prepare duplicates which may be

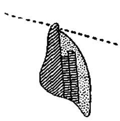


FIG. 361

used in case of an accident. In any event, the shades and mold of the crowns or facings used should be placed on record. In grinding in the duplicates, whether crowns or facings, they should be made very exact so that if it were necessary to replace one, the duplicate could not be told from the original. Each crown should be ground separately, with all of the others in position.

If duplicates are to be made of the six anterior teeth, they should be taken one at a time, removing the cuspid first and grinding in the duplicate cuspid so that it exactly corresponds with the original. After this has been completed, the original cuspid is replaced and the lateral removed and the duplicate lateral ground in. After which the original lateral is replaced and the central removed and the new one ground in place and so on until duplicates of the entire set have been made.

In this way as many duplicates as may be desired can be made with the knowledge that they are all absolutely interchangeable. This same order should be followed whether facings or crowns are being used.

EXTENSION BRIDGES.

In a very large majority of the smaller extension bridges which are made, where the whole or a portion of the body of the bridge extends beyond the single abutment, as in Figs. 362 and 363, the entire principle is faulty and the whole piece a mechanical impossibility. Notwithstanding this, pieces of this description are placed in mouths to the detriment of the patients. Sooner or later the

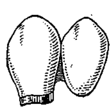


FIG. 362

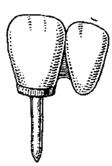


FIG. 363

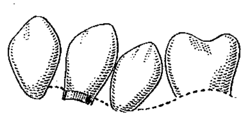


FIG. 364

abutments to which these pieces are anchored are sure to be forced out of their normal position and frequently are lost. In the anterior part of the mouth, where an appliance, such as shown in Fig. 363 has been inserted, the rotation and consequent loosening of the root is inevitable.

In Fig. 364, where a dummy having an occlusal surface is attached to a single abutment there is not only a strong lateral strain which will give a constant twisting motion to the root, but there is also a direct force which is being continually exerted, gradually tilting the abutment and forcing the dummy into the tissues (Fig. 364) with the resultant loss of occlusion and the eventual loss of the tooth to which the bridge is attached.

One inflexible rule applies in all of these cases and that is that *there must always be a support at each end of a bridge and never under any consideration should a single point of attachment be depended upon to carry a dummy.*

A small spur of platinized gold or iridio-platinum, attached to the lingual side of the dummy, and resting in a small gold filling or inlay on the lingual side of an adjoining tooth, as shown in Fig. 365, will entirely overcome the possibility of rotation, and will make the piece a permanent fixture rather than a temporary one.

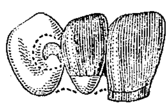


Fig. 365

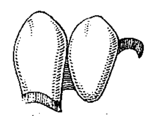


Fig. 366

A spur resting in the lingual side of the cuspid or in a filling or inlay in the fissure of a molar or bicuspid (Fig. 366), will effectually prevent future trouble and render a piece serviceable which would otherwise be worthless.

Extension Bridges with Saddles.—Extension bridges, in which saddles, resting on the ridge, are employed as an additional support should never be used in fixed bridges, as it is impossible to properly cleanse an appliance of this kind. Irritation and inflammation are sure to ensue, and its use will sooner or later result in the loss of the abutment teeth, if not in troubles of a more serious nature.

THE USE OF PORCELAIN CROWNS WITH SOLDERED BASE IN FIXED BRIDGE-WORK.

Where porcelain crowns are used in fixed bridge-work, there must be a depth of bite great enough to allow a sufficient mass of metal beneath the crowns to give strength and stability to the appliance, and at the same time allow of space enough on the lingual side between the base and the gum to permit of properly cleansing the piece. In any of the six anterior teeth, unless there has been a great resorption of tissue, the dummy crowns should be ground so that they will rest on the gum at the labial side, but be freely clear of the gum on the lingual, as in Fig. 367*a*.

After the crowns have been properly ground and arranged on the model, a wall of plaster should be built up on the labial side so as to retain them in position (Fig. 367 *b*). The lingual side and

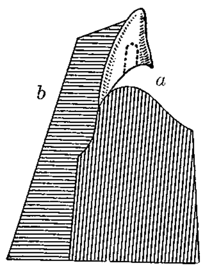


FIG. 367

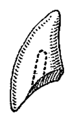


FIG. 368

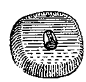


FIG. 369

on the mesial and distal about half or two-thirds the way to the labial should be beveled in order that the bases may come up over the edges of the crowns at these points and form a positive seat in which the crowns may rest (Fig. 368). They should all be ground symmetrically and on line one with another so that one will not stand conspicuously above its mates.

The foregoing will apply to the preparation of crowns for the posterior part of the mouth when the depth of the bite is not too great.

The bases for the crowns of pure gold, No. 35 or 36 guage, are first made. These may be fitted by swaging or burnishing, the gold extending up over the beveled edges of the crowns. Openings are made through the floors of the bases and through these openings posts of platinized gold are fitted. These are then waxed, removed, invested, and the posts soldered to the bases from the under side with a little piece of coin gold (Fig. 369). They are then replaced on the crowns, properly assembled on the model and waxed firmly together. It is a good plan to lay a piece of heavy iron or brass wire across the bases and wax it firmly to prevent their changing position while investing. The crowns are then removed and the bases invested, leaving the under surface well exposed. It will assist materially in soldering, if a small wire of coin gold is placed throughout the length of the piece on the lingual side and the solder built up to that (Fig. 370).

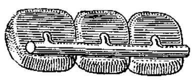


Fig. 370

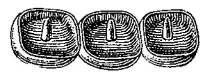


Fig. 371

After soldering, the piece is cleansed in acid, polished and finished, except at the points where it is to be united to the abutment caps (Fig. 371). The crowns are then put in place on their bases and carefully adjusted on the model, and the bases waxed carefully to the abutment caps. The crowns are then removed and the abutment caps, together with the crown bases, are invested and united with 20- or 21-carat solder. After the piece has been cleansed and polished, it is ready for the cementing of the crowns. The pin holes in the crowns are filled with cement, as are the bases, and the crowns are forced into place and kept under pressure until the cement has well hardened, after which the excess of cement is trimmed away and the bridge is ready for the mouth.

Use of the Cast Base.—If the bases are to be cast, posts of platinized gold may be fitted into the post-holes in the crowns, or the posts may be made at the same time the base is cast, by forcing a small, pointed piece of inlay wax in the hole in the base of the crown and this being united with the wax base becomes a part of the casting. The bases of the crown should be lubricated with cocoa butter or glycerin, and a piece of tin foil or oiled paper fitted over the ridge to protect the model from the wax and permit of their easy removal, and the space between the crowns and the paper filled in with inlay wax, after which it is removed and carved, cutting away enough of the wax on the under side lingually so that it will clear the gum sufficiently for cleansing purposes.

The crowns should be removed and replaced several times to make sure that they are perfectly free.

If there should be not more than two or three bases to be made they may be cast in one piece. If the four incisors are to be restored it is better to divide the base at the median line and cast the two halves separately, afterward uniting them with solder.

The sprue wire is firmly attached to the lingual side, and this should be done before finally removing the crowns, so that there is no likelihood of distorting the wax on the inside of the base (Fig. 372).

In the posterior part of the mouth, where the gold is not likely to show, the bases may be carried through to the buccal side, and

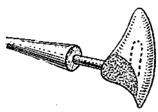


Fig. 372

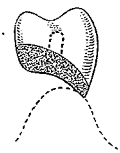


Fig. 373

in such cases the base of the crowns are beveled slightly all around so that they may be firmly seated. They should be cut high on the lingual side, the same as the anterior crowns, for cleansing purposes (Fig. 373).

CHAPTER XII.

REMOVABLE BRIDGE-WORK.

With the advent of removable appliances, the possibilities of bridge-work have been greatly increased. The field of operations has been extended so as to include, not only many cases where fixed bridges have been worn, but also a great many others where, up to that time, the only hope of the patient was a plate, more or less satisfactory.

The advantages of removable bridge-work over fixed bridges are many, and it is very questionable whether there is a single instance where fixed bridge-work answers the purpose better than removable. It is undoubtedly true that in almost every case where fixed bridge-work has been placed, removable bridge-work could have been used to a much better advantage and would have given far greater satisfaction to the patient. Then again, there are many cases where conditions are such that a removable bridge is indicated, where a fixed bridge should not be thought of.

From a hygenic point of view, there can be no question as to which is the best. A removable piece can be taken from the mouth and thoroughly cleansed and sterilized by boiling or any other method which the patient may desire. When the bridge has been removed, the abutment caps, being perfectly simple and easily accesible, can be thoroughly cleansed at every point.

In the case of a bridge which is immovably fixed to its supports, there are spaces and crevices in which particles of foodstuff or other material may lodge, which cannot be reached even by the dentist. It is impossible to thoroughly cleanse and sterilize such a bridge, as there is nothing which can be taken in the mouth that is of sufficient strength to perfectly cleanse and sterilize it without injury to the soft tissues.

Another advantage, which a removable bridge possesses over a fixed bridge, is the facility with which it can be repaired in case of an accident. The bridge can be removed and the entire work of repairing can be done in the laboratory, without the slightest inconvenience to the patient. In the case of extensive damage to a fixed bridge, it is frequently necessary to so cut and mutilate it, in order to remove it from the mouth, as to nearly destroy it, necessitating, in many instances, practically the making of the entire bridge over again.

This is especially true in a case where there are many abutments. In making extensive restorations, where there are a large number of anchorages, a fixed bridge should never be placed. It may at any time happen, that in cementing a fixed bridge of this character, from one cause or another, the cementing of one or more of the abutments has been faulty, and before this is discovered, these roots have been entirely destroyed through leakage and decay. It would be impossible for this to happen in the case of removable work, for should one of the abutment caps become loosened, it will manifest itself at once by coming away with the bridge, in which case it can easily be recemented, rendering the piece as firm as ever.

Another very decided advantage in a removable piece is the facility with which affected teeth adjacent to the bridge may be treated. Every dentist has probably had the experience of undertaking to place a gold filling in an approximal cavity in a tooth adjoining a fixed bridge.

If the bridge be removable, it can be taken from the mouth, leaving ample room for any operation which may be necessary. With the advent of cast gold inlays, these operations have been much simplified. The insertion of such an inlay is not nearly so difficult as was the putting in of a gold filling by the old method. But the fact remains that we can much better place an inlay if, by the removal of the bridge, we have ample room in which to work.

The value of removable bridge-work depends entirely upon the attention given to the numerous details, and upon the accuracy with which the work is done. The fittings must be as nearly perfect as it is possible to make them, otherwise the work will not prove a success. The training which one gets in doing this class of work, tends not only to make him more proficient in bridge-work, but more proficient in every branch of the profession, as the care and skill required develops a delicacy of touch, and exactness in manipulation to a far greater degree than does the ordinary routine of the dental work-room.

ATTACHMENTS FOR REMOVABLE BRIDGE-WORK.

Retaining and Supporting Abutments.—There are two classes of abutments in both fixed and removable bridge-work, and these are known respectively as retaining abutments, and supporting abutments.

By a retaining abutment is meant an abutment which not only gives support to the bridge, but also retains it in its proper position in the mouth, as in the case of a Richmond crown, shell crown, telescope crown and others of a similar character.

A supporting abutment is one which gives support to the bridge, but has nothing to do with its retention. An example of an abutment of this kind would be where a spur is resting in a gold filling or in an inlay in an adjoining tooth, and serving simply to prevent any lateral movement and to resist the force of occlusion.

RETAINING ABUTMENTS.

There are many different styles of attachments for removable work, and the writer will describe those which he has found most useful, and which have the most variable application. In discussing these different attachments, we will first consider those which are most frequently indicated in the posterior part of the mouth for the molars and at times for the bicuspids. The first of these is the telescope crown.

The telescope crowns should not be confounded with the shell crowns, which are simply, as the name indicates, shell caps fitted to the stumps. The telescope crown is really a crown in which one part telescopes the other with the ease and accuracy of the slides of a telescope.

Telescope Crown.—This crown is especially adapted to the molars, and where great strength is required, or where the gold can be hidden, as far forward as the second bicuspid, and at times even the first, but should never be carried beyond the first bicuspid, and rarely to that tooth. The telescopes may be used where there are two retaining abutments, providing the telescope can be made of sufficient length to give a permanent and firm grip.

Alloys Suitable for Making Telescope Crowns.—The alloy suitable for a telescope crown must possess great tensile strength and rigidity, and also a certain amount of elasticity. The 22 carat gold alloyed with silver, which is most commonly sold at the dental depots, is altogether unsuitable for this work, the silver alloy rendering it soft, with the result that if this were used, the strain which is necessarily brought to bear on the bridge will cause the gold to stretch and so render the crown worthless within a comparatively short time.

The best results have been secured by using a copper alloy, and the writer has found the American coin gold, 21.6 carats fine, to be the most suitable for this purpose. It is tough, strong and rigid, and experience shows that it will wear better than any other high carat alloy.[1]

It is not necessary, and perhaps not always desirable, that the abutments for a removable bridge should be exactly parallel, but they must be very nearly so. The pericemental membrane acting as a cushion, permits of a slight natural spring to the teeth which can be taken advantage of to help hold the bridge firmly in position. If the natural inclination of the teeth is such that they diverge slightly, they can be trimmed and the bands so fitted to them that the bridge can be made to accommodate this inclination. The result will be that as the bridge is placed in position, the teeth are drawn together very slightly and then spread apart and resume their normal position as the bridge is forced home. If the teeth converge, when the bridge is put in position, they are forced apart very slightly, resuming their normal position when the bridge is in place.

This movement of the teeth, of course, must be very slight, for should it be very great, it would have a tendency to loosen the teeth, but the slight natural spring will do no harm, and as before stated, will help to hold the bridge more firmly in its place.

In a telescope crown which has been carefully and accurately made, there will be practically no wear even after they have been in use for years. The fluids of the mouth forming a coating which protects the metal so that there is in reality no actual contact between the outer and inner caps. On the other hand, if the fitting has not been accurate, and there is the slightest play between the outer and inner caps, there will be a very decided friction which will, in a very short time, render the piece worthless.

The Technic of the Telescope Crown.—The trimming of a tooth for a telescope crown is done in practically the same manner as for an ordinary shell crown, being ground so that the stump is tapering, and being slightly larger a little below the gum line, the only difference being that the occlusal surface should be cut

[1] Within the past few years Mr. L. J. Weinstein, of New York, has been making extensive experiments in dental alloys for this and other work, and has produced some which gives excellent results. A chapter by him in another part of this work will prove interesting and valuable reading, not only to the crown and bridge specialist, but to the general practitioner as well.

away a little more than for a shell crown, as there is a greater thickness of metal at the occlusal end in a telescope crown than in a shell crown.

The measurement of the stump is taken in the manner described directly across. The band should be cut to this measurement, the ends being nearly parallel, but not quite, flaring a little and being slightly longer at the gingival edge (Fig. 374). The length from

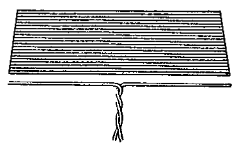


FIG. 374

the occlusal to the gingival edge of the band should be such that it will extend from well beneath the gum line to a little above the occlusal end of the stump, or nearly in contact with the occluding teeth.

The thickness of the gold of which the band is made should be number 30 Brown & Sharpe gauge. One end is beveled to a knife edge and the other overlapped and the two parts sweated together. The band should then be shaped carefully to conform to the shape of the stump and festooned accurately to follow the gum line, being certain to have it nearly parallel with other abutments. In shaping it to the stump, care should be used not to wrinkle the band, but to keep it perfectly smooth. The gingival end should then be beveled slightly from the outside, any feather edge which may have been turned over by the scissors or the file being removed, so that it will pass freely under the gum without mutilating it or causing the patient unnecessary pain. It should be remembered that the occlusal end of the band should have exactly the same shape as the gingival end, or in other words, the occlusal end of the band should follow parallel with the gingival.

It is important that this be done accurately, for should the occlusal end not have the same outline as the gingival end, if it be pressed together too much mesially and distally, or buccally and lingually, it will be conical from this direction (Fig. 375), but will be forced out at the occlusal end at the other sides, giving it a flaring top which would render it impossible to perfectly fit the outer band (Fig. 376).

The band is then placed on the stump, forcing the gingival edge to nearly one-sixteenth of an inch below the gum line. An

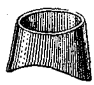


FIG. 375

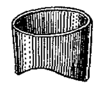


FIG. 376

impression is then taken and a model prepared in the manner which has been already described. After the model has been separated from the impression and neatly trimmed, the band may be removed by grasping it with a pair of heated pliers. The model should then be thoroughly dried, treated with several coats of thin sandarac varnish and then again dried to harden it before proceeding with the work. This being done, the band is replaced on the stump, and enough of it cut from the occlusal end to allow for a thick strong cusp. The extreme occlusal edge of the band is then turned inward slightly all around (Fig. 377), care being taken to keep the edge parallel with the gingival end of the band.

The object of turning the edge of the band in, is to give this end of the cap a slightly rounded form in order to facilitate the placing of the bridge over it in the mouth. If this were not done, and the top of the cap was left with a sharp, square edge all around, it can readily be seen by the illustration (Fig. 378), that if

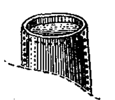


FIG. 377

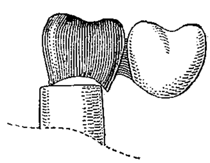


FIG. 378

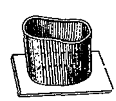


FIG. 379

the abutments were the least out of parallel, the edge of the outer cap would catch on this square edge and render the insertion of the bridge very difficult. If the top edge of the cap is rounded slightly, the outer cap will slip over it from almost any position, and the bridge can be dropped in place very easily.

The occlusal edges of the band having been turned in, this end is filed perfectly flat and the floor of No. 28-gauge coin gold is flattened in the swagging device and sweated to it in the same manner as already described in the making of the cap for a Richmond crown

(Fig. 379). The extending edges of the floor are then trimmed flush with the band, and the sides of the cap are nicely smoothed with a file or a fine disk and polished. The floor of the cap is not polished at this time, the reason for which will be given later.

The inside of the cap is then given a very thin coating of wax. After the wax is applied, all the excess that can be removed is scraped away with the spatula. The cap is next grasped with pliers and passed quickly through the Bunsen flame so as to distribute the little remaining wax evenly, leaving only a very thin film. If there is too thick a coating of wax on the inside of the cap, it can easily be pulled away from the fusible metal stump, or it will be found that when the outer band is driven over, the wax will be squeezed out around the edges, allowing the inner band to buckle, with the result that the work will have to be done over again (Fig. 380).

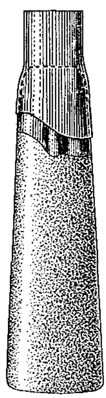


FIG. 380

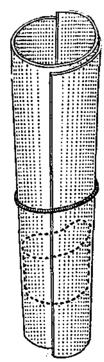


FIG. 381

A tube of paper is then made, or a piece of rubber tubing may be used, and the band pushed well down into it so that the gingival edge is an inch or more below the upper end of the tube. The paper tube should fit the cap tightly, and is held in place with a gum band or piece of wire (Fig. 381). The tube is now filled with fusible metal which is allowed to cool thoroughly before removing the paper. Fig. 382 shows a ladle especially adapted for fusible metal, when used in small quantities. It has a long, narrow lip, which allows of the metal being poured into a very small opening as the paper tubes in which the caps are placed. The ladle will also hold enough metal to pour a large-sized die for a saddle.

The metal used for this purpose should have a very low fusing point. Melotte's metal, or any of the metals which require a higher heat than the boiling point of water to melt, are not suitable for this purpose. The metal which the writer has found most

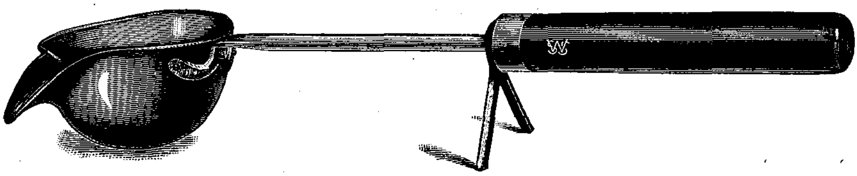


FIG. 382

suitable for thus reinforcing the caps is made from the following formula of Dr. C. M. Richmond, which was published many years ago in one of the dental journals.

Tin	20	parts.
Lead	19	"
Cadmium	13	"
Bismuth	48	"
	100	"

They are not melted in the order of their fusibility, but in the order in which they are given, as the metals combine better if melted in this manner. A new crucible should be used for the purpose, or one which has been used only for the making of the metal. The tin is placed in the crucible and heated until it is entirely melted and as soon as this has taken place, the lead is dropped in. When this has also melted, the cadmium is added and when this too has melted, the crucible should be taken from the fire, or the fire should be turned out. The bismuth is then added in pieces and stirred in with a pine stick until it is entirely melted. It must not be forgotten to remove the crucible from the fire as soon as the cadmium has disappeared. If this is not done before adding the bismuth, the fusing point of the mass is lowered so rapidly that the metal will burn and become worthless for the purpose for which it is intended.

This metal fuses at about 160° F. It is quite hard and does not shrink at all on cooling, and after using, it can readily be removed from the gold cap by placing it in hot water.

The metal-filled cap having become quite cold, the paper is removed and a perfectly solid and rigid stump results, over which it is possible to make a perfectly-fitting outer cap, and the surplus metal extending as it does over an inch or more beyond the cap, makes a convenient handle by which to hold it for further operations (Fig. 383).

It is well to emphasize the fact that the band should be thoroughly polished before filling it with the fusible metal. Being reinforced, and having the extending stump for a handle, it would be easier to polish and finish it after it has been filled with the metal, but there would be danger of future trouble should this be done. Should the band be polished at this time, it would be impossible to prevent the polishing wheels from coming in contact with the fusible metal. The surface of the gold of the inner cap would thus become contaminated, so that in fitting the outer band it would in turn become contaminated from the film of the base metal which has been brushed over the inner cap, even though it could not be seen, and the band, at the first annealing, by alloying with the base metals would become so brittle as to be absolutely worthless.

It cannot be too strongly impressed upon the reader, the danger of the precious metals becoming contaminated by contact with base metals on the work bench. The greatest care should be used to keep them from unnecessary contact. Even the slightest trace of any of these base metals or alloys will, on the piece being heated, as in annealing or in soldering, entirely destroy the working qualities of the precious metals, so that they are good for nothing until refined and remelted. All pieces swaged or fitted upon base metal dies should be given a bath in nitric acid before annealing or soldering.

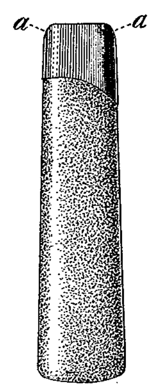


FIG. 383

The bench on which base metal has been used, and the instruments which may have been used around it, should be thoroughly cleansed before again coming in contact with gold or platinum.

Making the Outer Cap.—The measurement of the inner cap is taken just below the point where the occlusal end has been rounded (Fig. 383, *aa*), and the outer band cut from No. 30-gauge coin gold on an angle of the same degree, or even slightly greater than was the inner band (Fig. 374). This is then beveled and sweated together in the same manner as was the inner band, and afterward the lapped joint is hammered over the beck-horn of an anvil or squeezed between the jaws of the stretching pliers until the seam on the inner side is entirely obliterated. It is now annealed and given approximately the shape of the stump, and the inner cap is driven into it by placing the occlusal end of the band on the anvil and

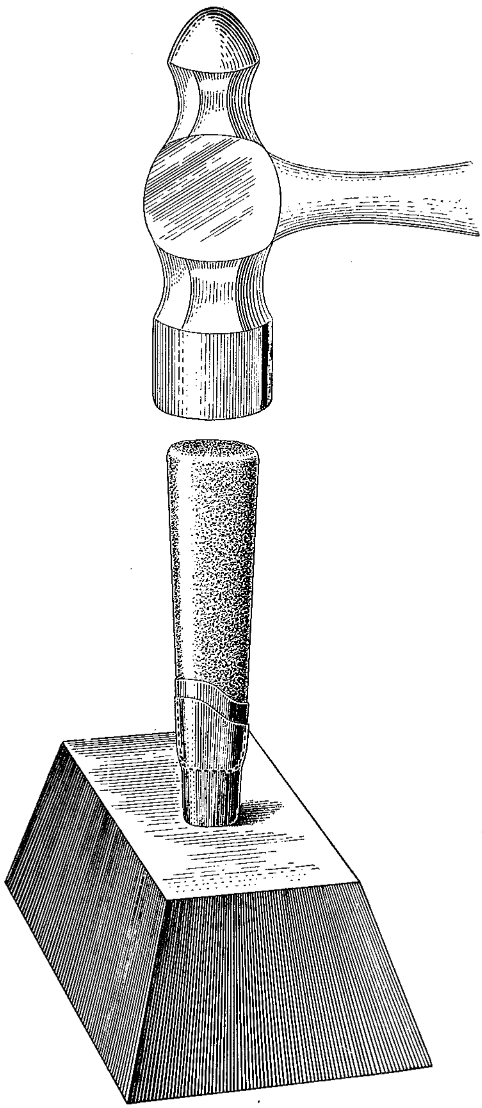


Fig. 384

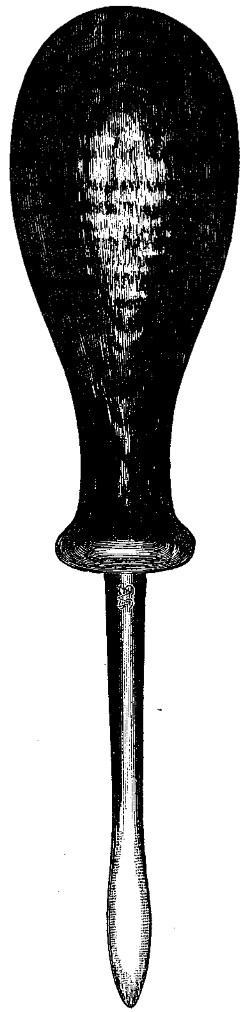


Fig. 385

tapping the end of the fusible metal stump with a small hammer, forcing it into the outer band which is thus stretched over it, as in Fig. 384.

It should not be allowed to come in contact with the fusible metal except in such cases as will be described later. The band will be found to fit the inner cap so tightly as to render it immovable. This may be remedied by using a heavy steel burnisher (Fig. 385) and burnishing the sides of the band as it fits over the inner cap. This burnishing will stretch it very slightly, but sufficient to allow of it being removed from the stump. It should not be burnished so as to make it loose, but just enough to permit of it being forced off with an instrument.

The band is then marked and carefully trimmed to a line parallel with the gingival edge of the inner band, and again driven on until it comes to within a little less than one-sixteenth of an inch of the gingival edge of the inner cap (Fig. 386). The occlusal end is trimmed very nearly to the floor of the inner cap and then pressed in all around over the rounded edge of the inner cap so that it fits at this point closely (Fig. 386). This can be done with the face of a flat

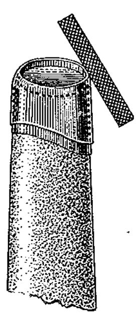


Fig. 386

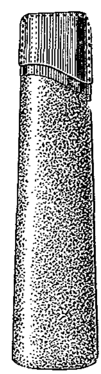


Fig. 387

file by giving it a rolling motion, laying it flat on the side of the band and rolling over the occlusal end. It should not be done by burnishing as the burnishing would stretch the metal at this point and make it impossible to obtain an accurate fit.

The occlusal end is then filed flush with the floor of the inner cap. In doing this and in making it perfectly flat, it will be necessary to file away some of the floor of the inner cap and it was for this reason that the floor was made of No. 28 gold (Fig. 387). We now have an outer telescoping cap which fits the inner perfectly, and there is no method which can be employed which will give so perfect a fit. The outer band is then removed and a floor of No. 30 coin gold is sweated to it. Up to this point, no solder has been used, so that in any subsequent soldering operations there is no possibility of any solder making its way to the inside of the cap through the seams, and thus destroying the fit.

The edges of the floor are then trimmed flush on the buccal and lingual sides of the cap, leaving it extend a little out from the cap centrally on the mesial and distal sides, as in Fig. 388, to assist in giving the cap a normal contour at these points.

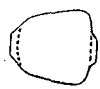


FIG. 388

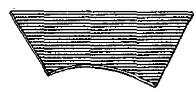


FIG. 389

It is essential that the contour of the cap or crown be restored so that it will present a normal appearance. This is done by building it out mesially and distally with coin gold. Pieces of No. 28 gauge coin gold are used, being cut about one-half or three-quarters longer than the buccal and lingual diameter of the cap and shaped approximately as in the drawing (Fig. 389), the gingival edge following the festoon of the band and coming to within about one-thirty-second of an inch of this edge and extending about one-thirty-second to one-sixteenth of an inch above the occlusal end.

These pieces of gold are called the contour wings. One is placed in position on the cap about one-thirty-second of an inch above the gingival edge, the other side resting on the extended floor of the

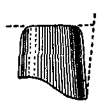


FIG. 390

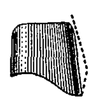


FIG. 391

outer cap (Fig. 390). This allows only the lower edge to touch the band and it prevents the solder from flowing farther up on the cap than intended. If the floor has been trimmed close to the band all around, the same result can be obtained by giving the wing a short bend close to the gingival edge as in Fig. 391. It is held in position with a pair of pliers and fluxed with liquid-flux[1] between

[1] A solution of borax and boracic acid.

the wing and the cap. It is then held over the flame of a Bunsen burner, drying the flux and thus holding the wing temporarily in position.

The cap is then placed on a charcoal block, the side on which the wing is tacked being uppermost, and it should so rest that the wing is nearly level. A very minute piece of 21-carat solder, no larger than a quarter of the size of a pin head is placed on the lower edge of the cap in contact with the wing, as in Fig. 392. The whole is now thoroughly heated up until the solder melts and the wing is tacked to the band with this small piece of solder. The cap is then cleansed in acid and the wing on the opposite side is attached in the same

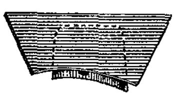


Fig. 392

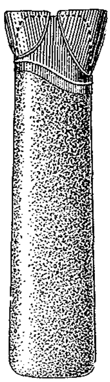


Fig. 393

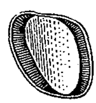


Fig. 394

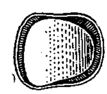


Fig. 395

manner. The cap is next placed on the stump and the wings are brought into shape with the pliers so as to give a contour to the crown, the ends being trimmed as may be necessary to give this result (Fig. 393). The fact of their being only just lightly tacked at the gingival edge permits them to be adjusted outward or inward or in any way desired to give the required contour. Fig. 394 represents an upper molar with the wings brought in proper position and Fig. 395, a lower molar.

When the wings have been brought into shape, the spring of the metal will be such as to keep the edges from actual contact with the band. To overcome this, it is necessary to anneal them while held in close contact, as follows: The edge of the contour wing is grasped with a pair of pliers, one beak being inside of the band, and the other resting on the edge of the contour wing, holding it in place. The flame of the blow-pipe is then thrown onto the wing, bringing it to a red heat, holding it in the pliers, as in Fig. 396, until it is cool. This will bring it in contact with the band, and overcome the spring of the metal. This is repeated at different places until all points of the wings are in contact with the band.

The cap is thoroughly cleansed in acid and after it is rinsed and dried, it is well fluxed between the wings and cap and also around the edges and buccally and lingually between the two wings. It is now placed on a charcoal block with either the buccal or lingual sides uppermost and a large piece of 21-carat solder placed between the ends of the wings, as in Fig. 397.

The whole cap is then thoroughly heated up with the blow-pipe and the solder drawn in between the wings and the cap and along the edges, using sufficient solder to flush it well between the edges of the wings and cap, but not enough to more than partly fill in between the contour and the band, as in Fig. 398.

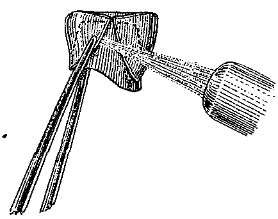


FIG. 396

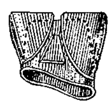


FIG. 397

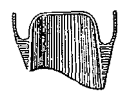


FIG. 398

The cap is then cleansed again and soldered on the opposite side in the same manner, bringing the solder flush between the ends of the wings, also along the lower edge between the wings and the band. It is then cleansed in acid and the extending wings cut and filed flush with the floor of the cap (Fig. 398). A suitable cusp button is selected, a pure gold matrix made, filled flush with coin gold and the under surface filed perfectly flat. This cusp may be selected after the band has been contoured, or it may be selected before and the contour brought out to correspond with the cusp.

The edges of the cusp should extend slightly beyond the contour. After it has been filed perfectly flat, the under surface is fluxed as well as the floor of the cap at the point of contact and held in the flame of the Bunsen with a pair of pliers, until the flux has dried, thus tacking the cap and cusp together. The cusp and cap are then wired tightly and placed on the charcoal block, as in Fig. 399.

A large piece of 20-carat solder is placed on the buccal or lingual side of the cap, resting on the extending edges of the cusp. The flame of the blow-pipe is directed on the cusp which should extend a little over a depression in the block so as to allow the cusp, which

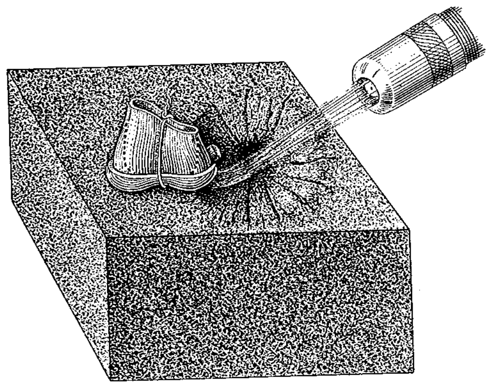


Fig. 399

is very thick and heavy, to be thoroughly heated up first, and the solder melted (Fig. 399), flowing it in between the floor of the cap and cusp. The cap can then be placed on its side, as in Fig. 400, and the cusp first heated thoroughly and the flame then passed over

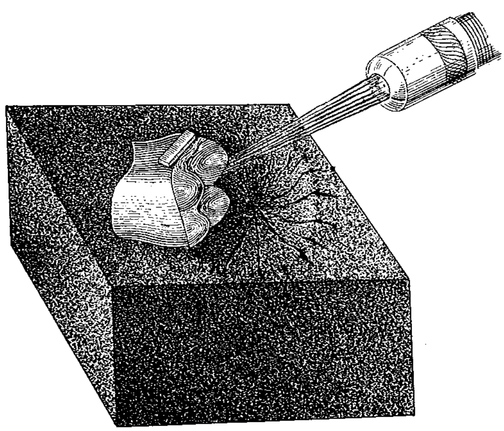


Fig. 400

the upper and lower edge. Fresh solder is added and as it melts, it can be drawn through from one side to the other, uniting the cusp and the cap firmly.

The solder should always be drawn from one point and enough of the solder should be used to be certain that it is drawn entirely through and filled flush all around the edges of the contour, uniting the cusp thoroughly at all points. If the operator were to start at one point and unite it there and then turning the crown and uniting it at different points all around on the outside, he might afterward find that it was perfectly soldered on the outside, but the solder had not drawn entirely through from one side to the other, and that the entire floor of the cap was not united to the cusp. The possible result would be that in future operations, when the piece has been very highly heated, that the floor of the cap at the point where it was not united with the cusp may have expanded and bulged inward as in the illustration (Fig. 401), leaving a large blister at this point. If this does happen, the cap may be placed on a block and the bulged floor driven back into place with a stick. This can be accomplished so that very little or no harm will result, but the appearance of the cap on the inside is spoiled.

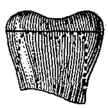


FIG. 401

After the cusp has been soldered, the extending edges are ground off flush with the contour and the whole crown is finished and polished. The outward appearance of the crown is now the same as an ordinary contoured shell crown, but at the same time, it fits the inner cap perfectly.

After the telescope crown has been completed, the inner cap is removed from the fusible metal stump by immersing it in boiling water. The cap is grasped in a pair of pliers and as the metal softens, the cap is lifted from the water and any metal remaining in it is shaken out while it is still hot.

The cap is then thoroughly dried and placed in chloroform to dissolve any wax which may remain on the inner surface of the crown after which it is placed in nitric acid and left for a time, or else boiled in the acid in a test tube, so as to remove any traces of the fusible metal, as the slightest trace of this metal left in the cap would, should it be reheated, render it brittle and worthless.

Casting Cusps and Contour.—It is well to say a word at this point in regard to casting the cusp and contour on the telescope caps. It has been advocated by some, that the outer cap be made in the manner described, up to putting on of the contour, and the cusp and contour be then molded in wax. This is then invested and cast in the customary way. A telescope crown made in this manner will not fit the inner cap. The contraction of the metal is such that the outer cap will become too small, and it will be necessary to grind it on the inside in order to make it go over the inner cap, thus destroying the fit, and defeating the object to be attained, an accurately fitting telescope crown, beside making the crown unnecessarily heavy.

The contours of the telescope crowns are always mesially and distally, except where the teeth are in an abnormal position. A molar or a bicuspid may be turned one-quarter around. Then the contour would be placed buccally and lingually, as the tooth stands in the arch, but at the same time it would really be on the mesial and distal sides of the tooth, as in the illustration. Fig. 402 shows a rotated molar and Fig. 403, a bicuspid.

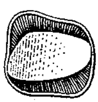


Fig. 402

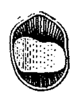


Fig. 403

As previously stated, the telescope crowns should be used in the posterior part of the mouth only, and never, under any circumstances, anterior to the bicuspids.

THE TELESCOPE CROWN IN COMBINATION WITH THE TUBE AND SPLIT PIN.

This crown is indicated where there is but a single retaining abutment for a bridge, or where there are two retaining abutments, but the crowns are so very short that it will be impossible to get sufficient hold with a simple telescope crown. It is nearly always indicated in the lower third molar, and very frequently in the second lower molar.

As is usually the case with the lower third molars, the crown is very short, and at times on the distal side, it is necessary to cut the stump nearly flush with the gum, or even beneath it, in order to place a cusp thick enough to give strength and support to the body of the bridge which is to be connected with it.

It is also frequently indicated in the upper molars, and at times in the lower bicuspids, but very rarely for the upper bicuspids.

The Construction of the Telescope Crown with the Tube and Split Pin.—The inner band is made and fitted to the stump in exactly the same manner as for the ordinary telescope crown. If the crown of the tooth is of sufficient length so that the depth of the pulp chamber, from the floor to the occlusal end of the stump, is in the neighborhood of three-sixteenths to one-quarter of an inch, it is not necessary that the tube should go in deeper than to the pulp chamber floor. If, however, the crown is very short, it may be necessary to drop the tube for a little distance into one of the roots. In the lower molar, it is generally advisable to utilize the mesial root for this purpose, as the position of these teeth is frequently such, that the mesial root stands at a better angle to receive the tube, as in Fig. 404. It is only necessary to drop the tube for a very short distance into this root, and as a general rule, owing to the lingual inclination of the tooth, it would be placed toward the lingual side.

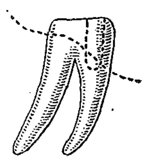


Fig. 404

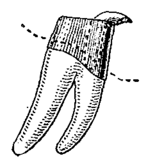


Fig. 405

In the upper molars, the palatal root is the best, as it is of a greater size than are the others. The band is placed in position and a heavy wire, of a slightly greater diameter than the tube which is to be used, should be placed in the pulp chamber or the enlarged canal, resting on the bottom, and held lightly in position with some soft wax and bent so as to clear the bite, as in Fig. 405.

The impression and articulation are then taken. When the impression has been obtained, the pin and band will often come away with the impression. Should they not do so, they can be removed and replaced in the impression, after which they are properly waxed in place and the sides of the pin lightly covered with wax. The impression is then varnished and the model is made and separated in the usual manner, the band and pin removed and the model dried.

The edges of the occusal end of the band are turned in slightly, the same as in the regular telescope, and a floor of No. 28-coin gold is sweated to it, and the excess gold of the floor trimmed away. By observing the hole in the stump, where the heavy wire has been removed, it can be ascertained about where the hole should be drilled in the floor of the cap for the reception of the tube. The hole in the floor should be made of a diameter about one-half greater than the diameter of the tube which is to be used (Fig. 406). The tube, with the mandrel inserted, is then placed through the opening, in the floor of the cap while the cap is on the model, the lower end resting on the floor of the pulp chamber or on the bottom of the cavity made to receive it, and adjusted so that it will be parallel with the anterior abutment (Fig. 407).

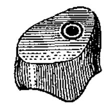


FIG. 406

The tube must also be adjusted so that the outer cap, when the crown is finished, with the pin in position, will draw freely from

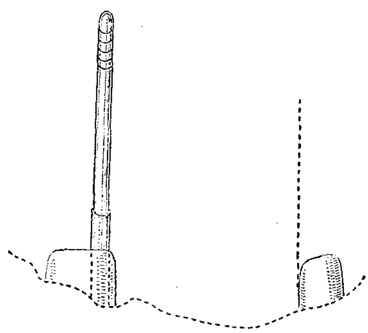


FIG. 407

the inner cap. This should be tested carefully while the tube is waxed in position, before investing and soldering. This may be done by leaving the mandrel in the tube and testing it from all sides with a flat instrument or a small straight edge placed against the sides of the band, as shown in the illustration (Fig. 408). The cap being slightly conical, it is not necessary that the tube be perfectly parallel with the sides of the band at any point, but it must be in such a position that it will draw freely.

By placing the edge of a flat file on the side of the band on a line with the mandrel, if, as the mandrel and file leave the band, they are parallel or converge toward the upper end from all sides, it will be known that the outer cap will pass over freely after the pin has been soldered to it (Fig. 408). On the contrary, if, as the mandrel and file leave the band, they diverge, as in the illustration, it can readily be seen that it will be impossible to make an outer band which will fit the inner band accurately and have it draw with the pin of the outer cap in place, as shown in Fig. 409.

As stated above, the diameter of the hole in the floor of the cap should be considerably larger than the outside diameter of the tube to permit, when the tube is soldered in place, of countersinking

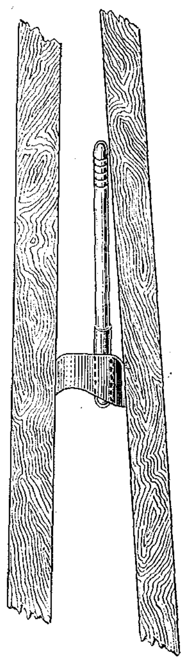


Fig. 408

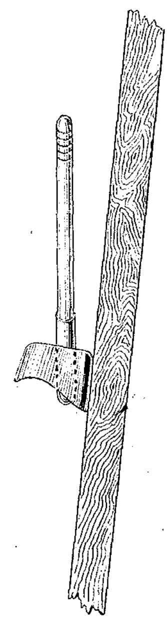


Fig. 409

it well at the entrance, so that the pin may readily find the opening. The tube should be in the center of the opening and the wax flowed around it to a depth of about one-thirty-second to one-sixteenth of an inch beneath the floor.

The wax is then chilled, the mandrel removed from the tube, and the cap invested, care being taken to have the inside perfectly filled with investment, and it is then ready for soldering (Fig. 410).

The invested piece is then warmed slightly and the wax removed, after which it is thoroughly dried out and heated to redness and the tube sóldered in place with 20-carat solder. This is best done by using the solder in a strip, having first fluxed the tube and edges of the floor at the opening.

The solder is held as shown in the illustration, and as the flame of the blow-pipe melts it, it is pushed through the opening around the tube to the under side of the floor, filling the space which has been left by the melted wax (Fig. 411). After it has been soldered, it is removed from the investment, cleansed in acid and dried.

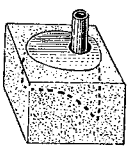


FIG. 410

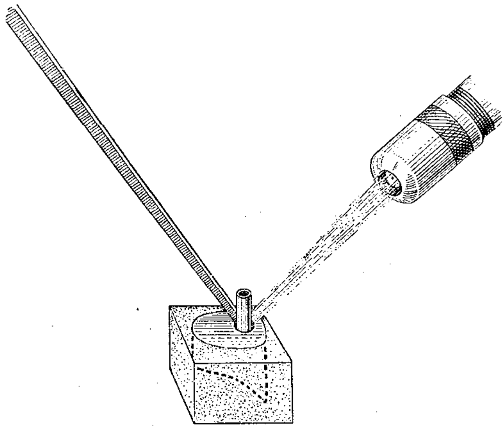


FIG. 411

The tube should be thoroughly dried out before cutting off the excess, as should moisture be left in it, the filings, working into the tube, will form a sort of paste which is difficult to remove, while if it is perfectly dry, the filings can be readily shaken out, with the saving of quite a little time.

The cap is then smoothed and polished, waxed lightly on the inside and filled with fusible metal, the same as for the regular telescope.

The measurement is taken and the outer band made. In a case of this character, where the crown is very short, it will probably be necessary to carry the outer band down over the fusible metal stump, for the time being, in order to secure a fit and a hold on the inner cap sufficient to allow of the turning in and filing of the occlusal end of the band to conform with the inner cap, as shown in the illustration (Fig. 412).

The edges having been turned in at the occlusal end to conform to the rounded corners of the inner cap, it is filed flush with the floor of the inner cap, enough of the floor being filed off to make it perfectly flat and smooth on the surface. The outer band is now removed and cleansed in nitric acid. Unless this be carefully observed trouble will surely follow. The gingival end is shortened and festooned to follow the edge of the inner cap, but from one-thirty-second to one-sixteenth of an inch shorter (Fig. 413), and a floor of No. 30 coin gold is sweated to it.

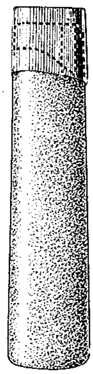


Fig. 412

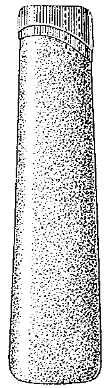


Fig. 413

In the making of a telescope crown it should be remembered that after the outer band has been filed flush with the floor of the inner cap and removed, it should always be wiped out thoroughly on the inside before sweating the floor to it. If this precaution is omitted or if any of the filings or dust should adhere to the inside of the band, they will become sweated to the sides during the process of uniting it to the floor. This would render the inside of the band rough, and would result in the scratching of the inner band when the outer cap is being removed or replaced.

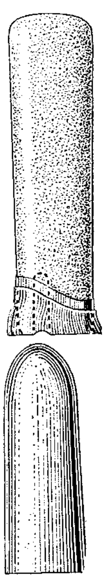


Fig. 414

The floor of the cap is trimmed, as in the case of the regular telescope crown, being made flush on the buccal and lingual sides and extending slightly beyond the band mesially and distally. The band is then contoured with wings and solder in the same manner as in the making of a regular telescope crown.

The opening in which to place the split pin should now be located. The floor of the inner cap having been filed perfectly flat and smooth, the inner edges of the tube are sharp and clear, like the edges of a steel die. The outer cap is placed over the inner cap, and the floor of the outer cap, at the point over the entrance to the tube, is placed on the end of a soft pine stick and the fusible metal stump struck a sharp blow (Fig. 414), indenting the floor into the tube and leaving on the inside a clear sharp outline of the opening (Fig. 415).

The next operation is to countersink the tube and fit the pin to it. The split pin should fit in the floor of the outer cap tightly, so that no excess of solder can pass through to the inner side of the cap; in this it is not like the tube in the inner cap which fits loosely.

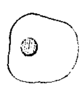


Fig. 415

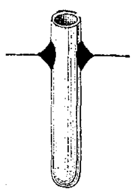


Fig. 416

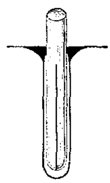


Fig. 417

Fig. 418

Fig. 419

It is advisable here to emphasize a most important point which applies in all cases where tubes are used. It is well known that a molten mass of metal contracts on cooling. Thus the placing of a large amount of solder around the tube results in its contraction. It is evident that if the pin were made to fit the tube, without first enlarging it at the opening, it would touch only at the point where it had been soldered, leaving the lower end free in the tube.

For the sake of illustration, these conditions have been somewhat exaggerated in the enlarged drawing (Fig. 416). It will be observed that the contraction of the metal around the tube has drawn it in so as to give it a neck smaller than the body of the tube. It will be noticed that the only point of contact of the pin with the tube is at the neck (Fig. 417) so that the entrance must be enlarged at the opening in each case sufficient to allow the mandrel over which the tube has been made to enter freely. This is best done with a flame-shaped finishing bur (Fig. 418). After the neck has been enlarged, the entrance to the tube is countersunk and smoothed in order that the pin may readily find the opening (Fig. 419). It should be remembered that this is not to be done until after the location of the entrance to the tube has been marked in the floor of the outer cap. The pin is then made to fit the tube and it should fit easily, but not loosely, or in other words, it should fit. A pin which fits a tube loosely does not fit at all.

The hole in the floor of the outer cap should now be made, the marking on the inside giving the position. It should be enlarged with the outer cap in position on the inner cap, just enough to allow the pin to pass through it and fit the hole in the floor of the outer cap tightly.

The selected cusp having been filled and filed perfectly flat on the under surface, is then placed in position on the outer cap, the pin for the time being having been removed. The under surface of the cusp is marked through the opening in the floor which was made for the pin (Fig. 420).

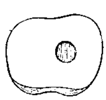


Fig. 420

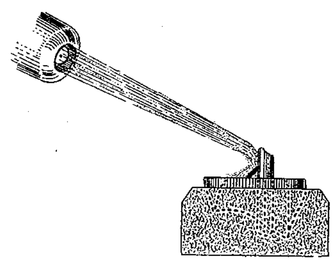


Fig. 421

The cusp is then removed, the pin replaced in the tube through the floor of the outer cap, with the split of the pin running buccally and lingually. The pin is waxed firmly in position, chilled, and the outer cap with the pin in place is removed from the inner cap and invested (Fig. 421). The inside of the cap should be moistened before filling with investment, so that the operator may be certain that it is perfectly filled and that there are no air bubbles, or any unfilled space around the pin on the inside of the cap, which would allow any of the solder to pass beneath the floor. It should then be heated-up and soldered with 21-carat solder, a very small piece being used for the purpose. The flame is first thrown on the split pin, as it is much heavier than the floor of the cap, until it is well heated. The flame is then lowered to the floor of the cap, drawing the solder around the pin and uniting it perfectly (Fig. 421).

A hole should then be drilled through the cusp at the point marked through the opening in the floor of the cap and enlarged sufficiently to allow it to readily pass over the pin extending through the floor, leaving space on all sides, as in Fig. 422. The pin should be cut off close to the floor so that when the cusp is soldered to the cap, the pin will be entirely covered with solder. The pin should not extend above the cusp so that it may be seen, as the color of this metal being much lighter than the cusps, if it is not covered with solder will show and spoil the appearance of the occlusal surface of the crown.

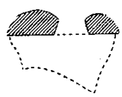


Fig. 422

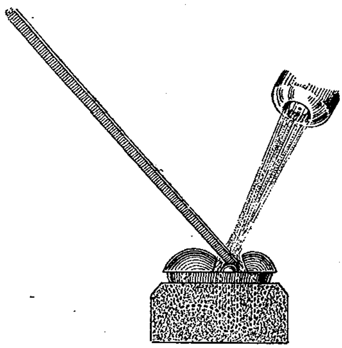


Fig. 423

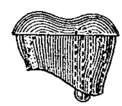


Fig. 424

The cap is invested, care being taken to fill it perfectly on the inside. The investment should extend about half way to the occlusal surface on the outside. The investment is now thoroughly dried and the floor of the cap and the under side of the cusp is well fluxed and the cusp is placed in position. It is then thoroughly heated and soldered with 21-carat solder, the solder being used in a strip, the end of the strip being placed in the opening through the cusp over the pin (Fig. 423). As the solder melts, the strip is pressed into the opening until it is drawn through from this point to all sides of the crown, and also filling the opening and covering the pin (Fig. 424). This is also an excellent way of uniting the cusp to the outer cap in an ordinary telescope crown, making a smaller hole in the center of the cusp, then wiring it in place and investing and drawing the solder to all parts through the hole in the center of the cusp. Soldered in this way there is little likelihood of there being any point between the floor and the cusp which is not perfectly united.

The crown is now removed from the investment, cleansed in acid and finished in the same manner as the regular telescope crown. If, on carving the cusps, it is found that the pin shows through the solder, it can be ground away with a bur or small stone and then covered again with a small amount of solder.

The inner cap is then removed from the fusible metal stump and thoroughly cleansed with chloroform and nitric acid. It must be remembered that the cap must not be put in the flame or reheated again, until it is certain that every trace of the fusible metal has been removed.

THE KEY AND SHOE ATTACHMENT.

Another style of anchorage, especially adapted to bicuspids and molars having long crowns, is the dovetailed key and shoe attachment.

The key is made of iridio-platinum and filed smooth to form a dovetail, as in Fig. 425, *A* and *B*.

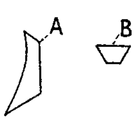


FIG. 425

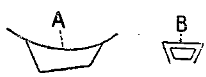


FIG. 426

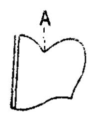


FIG. 427

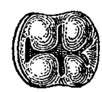


FIG. 428

A strip of the iridio-platinum, No. 32 gauge, is bent to fit the sides of the key perfectly and filed off flush with the face or broad side of the key, and a floor of the same metal fitted to it and soldered with a little pure gold (Fig. 426, *A* and *B*).

In using this form of abutment, the side of the crown to which the key is to be attached should be straight from the gum line to the top of the cusp and should be reinforced with a piece of No. 28-gauge coin gold soldered across the whole face of the crown with 21 carat solder and polished (Figs. 427 and 428).

The key is then put in place, a hole drilled through it and the side of the band to which it is attached with a small platinum rivet, such as a tooth pin (Fig. 429, *A*, *B*), the under surface of the

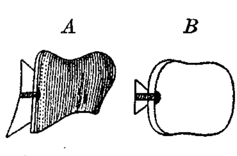


FIG. 429

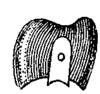


FIG. 430


FIG. 431

key having first been covered with pure gold, as the union between iridioplatinum and the solder is not strong. The key may then be tuned a little to the right or left, revolving it on the rivet (Fig. 430) to make it parallel with the other abutment.

After it has been adjusted, it is soldered to the cap, using a small amount 20 carat solder which is placed on the lower end of the key next to the band at point *c*, Fig. 429, *A*, and from there drawn to the upper end of the key, uniting it firmly to the face of the crown.

The female part of the attachment, or the shoe, is then slipped over the key and a thin piece of platinum plate cut out to slip down over it next to the crown (Fig. 431), and this is burnished closely to it. It is then waxed to the shoe, removed, invested, and covered with pure or coin gold, uniting it to the shoe and filling the sides flush, as in Fig. 432. After having been cleansed, it is trimmed to its proper dimensions, and replaced on the crown. The facings are now ground in and the bridge constructed. The shoe being soldered into the end of the body of the bridge as in Fig. 433.

FIG. 432

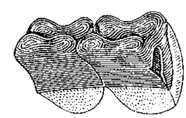


FIG. 433

If a saddle is to be used, the plate facing the crown, with the shoe attached, is carefully fitted to the saddle. The saddle is then waxed firmly to it, imbedding a piece of iron or brass wire in the wax along the shoe and saddle to stiffen it and prevent distortion while removing it from the key and crown, invested and soldered with 21-carat solder.

The necessary trimming and fitting is now done and it is replaced on the model and the bridge constructed, as will be described in Chapter on Saddle Bridges.

REMOVABLE ATTACHMENT FOR THE ANTERIOR TEETH.

These atttachments are designed for the teeth anterior to molars, where it is undesirable that any gold should be seen. The cap is made practically the same as for a Richmond crown, the stump being left standing out of the gum until after the tooth has been trimmed and the band fitted.

In fitting the band to the root, care should be taken to have it nearly parallel with the long axis of the tooth, as in Fig. 434, and any excessive inclination in any direction as in Fig. 435 should be avoided.

After the band has been fitted, the stump is faced in the same manner as for a Richmond crown, except that it should not be cut quite as far under the gum labially, for the following reason. In

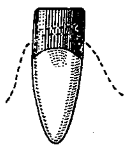


FIG. 434

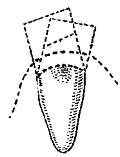


FIG. 435

a Richmond crown, the band should be from one-thirty-second to one-sixteenth of an inch beneath the gum on the labial side (Fig. 436), so that the band will be entirely hidden for a number of years. If the same procedure be followed with a removable piece, the band being far beneath the gum line allows the gum to crowd over the edge of the cap and onto the floor when the bridge is removed, so that when the bridge is replaced, the gum would be pinched between the outer and inner caps, and a constant irritation of the tissues result.

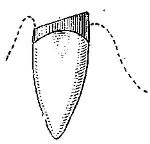


FIG. 436

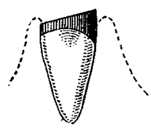


FIG. 437

The tooth should be trimmed from one-sixty-fourth to one thirty-second of an inch below the gum line on the labial side and should stand about the same distance above the gum line on the lingual side and the band trimmed flush with it. The placing of the floor on this will raise it high enough so that there will be little liability of the gum coming over the floor sufficiently to allow of its being pinched between the outer and inner caps (Fig. 437).

The canal is enlarged with reamers, which are made for the purpose, as far lingually as possible for the reception of the tube.

The band is then faced off and a floor of No. 28-gauge coin gold sweated to it. The surplus metal is trimmed away and a hole made through the floor to allow for the placing of the tube in position.

As in the case of the telescope crown with tube and split pin, the hole in the floor of the cap should be considerably larger than the outside diameter of the tube, so as to allow the solder to run through and provide for countersinking (Fig. 438). The cap is then placed on the stump, the tube placed in the root and held in position while it is being thoroughly waxed (Fig. 439).

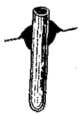


Fig. 438

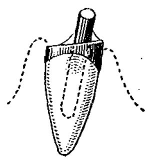


Fig. 439

After waxing, the cap is chilled with cold air or ice-water and removed from the root with the tube in position. This should be done by passing a hooked instrument under the gum and over the edge of the band, working from different sides, and moving it a little at a time, so as not to change the position of the tube in the cap. It should be noted whether the wax has drawn through to the under side of the floor of the cap on all sides and should there be any point at which it has not done so, a little wax may be added and the cap again tried on the stump.

The cap is then invested, care being taken to have the inside of the cap well filled with the investment, and soldered with 20-carat solder.

The same care should be exercised in placing the tube through the cap, to get the sides of the tube and the sides of the cap parallel or so that the outer cap will draw, as in the case of the telescope crown with the tube. The correctness of the inclination of the tube should be ascertained by placing a flat instrument on the lingual side of the cap and also on the mesial and distal sides, the mandrel being left in the tube while the test is being made. The correct relation of the tube on the lingual and mesial and distal sides of the cap is shown in Figs. 440 and 441, and under no consideration should they be placed in the position indicated in Figs. 442 and 443.

If after the tube has been waxed in position and it together with the cap is removed from the root, a condition similar to that shown in Figs. 442 and 443 is found, it should be replaced on the root to see if the relation of the tube and a cap have not been changed in removing it from the stump. If it is found that it has not changed, it may be necessary to make a new band throughout, tilting it enough in one direction or another so that a correct relation of the tube and cap can be obtained. No attention need be given to the relation of the tube to the labial side of the cap, as the half-band engages only the lingual half of the inner cap.

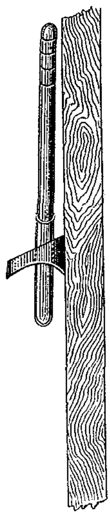


FIG. 440

FIG. 441

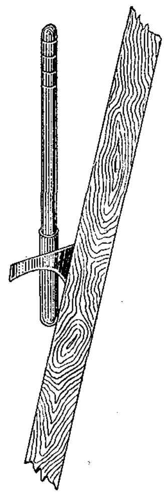


FIG. 442

FIG. 443

After soldering, the cap is removed from the investment, cleansed in acid and finished. The cap and the inside of the tube should be thoroughly dried out before doing any filing or grinding. The excess metal of the tube is cut away, the floor filed perfectly flat and the neck of the tube opened so that the mandrel over which it has been made, will enter freely, after which it is countersunk, leaving the edges of the opening perfectly smooth (Fig. 444).

Fitting the Pin in the Floor of the Outer Cap.—The pin is then fitted to the tube. The floor of the outer cap should be made of No. 28 gauge coin gold. A piece of the metal, a little larger than the cap, is selected, and the hole drilled through it at an angle corresponding to the angle of the floor of the inner cap with the tube. The pin should fit tightly into this, passing through the floor to the bottom of the tube, care being taken that the outer floor fits closely down to the floor of the inner cap at all points. The pin is then waxed to the floor (Figs. 445 and 446).

As the strain on any bridge is always buccally and lingually or labially and lingually, and never mesially and distally, in placing the pin in the cap, the split should always extend from the labial to the lingual sides, as in Fig. 447.

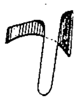


Fig. 444

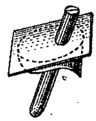


Fig. 445

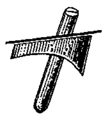


Fig. 446

Fig. 447

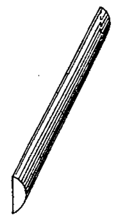


Fig. 448

Thus strength of the pin is far greater if placed with the split labially and lingually, than it would be if it were placed mesially and distally. This can readily be demonstrated with a strip of the half round wire, of which the pins are made (Fig. 448). It will be found that it can be bent very easily flatwise, but in trying to bend it edgewise, it will be very stiff. If the pin were placed with this split mesially and distally any lateral movement would have a tendency to bend the pin much more easily, the two surfaces sliding together, but by having the strain come edgewise on the pieces, far more than double the strength will be obtained than if it were placed reversely.

Investment should be made as in Fig. 449, making a small investment corresponding with the size of the piece to be soldered, care being taken to get the investment thoroughly around the pin on the under side of the floor where it passes through it. Very little solder should be used to connect this, the solder being placed at the mesial side of the pin in contact with the floor (Fig. 449, *a*) the pin and opening in the floor having previously been fluxed. It is then soldered with 21-carat solder. In soldering, the investment should be first thoroughly heated-up and after it has reached a red heat, a small blue flame is thrown directly on to the pin which is so much thicker and heavier than the floor that it requires a greater length of time in heating up. The flame is held on the pin until the melting point of the solder is nearly reached. It is then gradually lowered to the point of junction of the floor and pin and held there until the solder flows entirely around. The cap is then removed from the investment, cleansed in acid and dried.

The pin and floor are now placed in position over the inner cap and the floor trimmed just flush, and parallel with the sides of the cap (Fig. 450). This should be done with a file or a wheel, and care taken not to trim it to a bevel, as in Fig. 451, but to leave it flush, as in Fig. 450, otherwise when the half-band is put in position it could not be brought in contact with the floor of the outer cap.

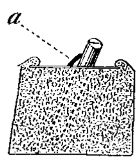


FIG. 449

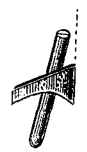


FIG. 450

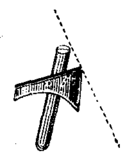


FIG. 451

Making a Half-band.—The half-band should be made of the same material and gauge as the floor of the cap, No. 28. It should not come farther labially than the labial side of the pin and should extend a little above the floor of the outer cap and down nearly to the lower edge of the inner cap (Fig. 452). It should be bent and fitted carefully so that it is in contact with the floor at all points, and when waxed tightly to the floor of the cap, removed for investment. The piece should first be moistened on the under side so that the investment may fill it thoroughly, as it is necessary that the corners should be well filled so as to prevent any solder from flowing through at this point.


FIG. 452

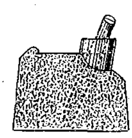


FIG. 453

On the lingual and mesial and distal sides, the investment should be only high enough to engage the lower edge of the half-band so as to hold it in position, as in Fig. 453. It is desirable to have the investment far enough below the floor of the cap so that it may be thoroughly heated at the point of contact between the half-band and the floor, thus allowing of its being more easily soldered. The investment is then dried out and the piece fluxed preparatory to soldering.

There is a correct way and a wrong way to solder the half-band to the floor of the cap. In the correct way, the solder should always be placed at one point and drawn from there all around where it is necessary to unite the parts (Fig. 454, *a*). If two pieces of solder are placed at different points, as in Fig. 455, *a a*, trouble is almost certain to result. The piece is heated-up and the flame flashed on to it, melting the solder at these two points. When the piece is heated, the gold will expand, and in the half-band, it being a long and narrow strip of metal, the expansion will be greater than it will be in the floor. The half-band, being united to the floor at

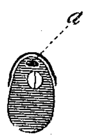


FIG. 454

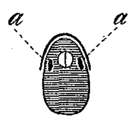


FIG. 455

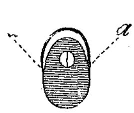


FIG. 456

FIG. 457

these two points, as in the illustration (Fig. 456, *a a*), when the flame is thrown on the lingual side, it will expand lingually and be pushed away from the edge of the floor (Figs. 456 and 457), with the result that the solder is drawn down through, as in Fig. 458, resulting in an ill-fitting band.

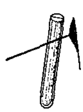


FIG. 458

FIG. 459

If the solder is placed at the lingual side as in Fig. 452, when the piece is heated from that side, to the melting point of the solder, the solder draws the half-band closely in contact with the floor. The metal expands as in the other case, but here it is held tightly to the lingual side and the ends of the expanding half-band are free to move buccally along the sides of the floor. By first melting solder at point *a*, Fig. 454, and then throwing the flame around both sides, the solder is drawn to the sides of the half-band, uniting it to the floor perfectly. It is then removed from the investment and cleansed and the lower edge of the half-band trimmed so that it will come not quite in contract with the gum (Fig. 459). The outer bands of crowns of this type or of a telescope crown should never pass beneath the gum margin.

PRECAUTIONARY MEASURES TO PREVENT BROKEN FACINGS.

The making of the outer cap for this form of attachment requires the greatest care, as the slightest deviation in technic may result later in great annoyance to both the patient and dentist through a series of mishaps in the way of broken facings.

In almost every case where a patient presents with one of these facings in the anterior part of the mouth broken, if the bridge is removed and examined, it will be found that the under side of the floor of the outer cap shows a very small polished surface just at the labial side, at point *a* in Fig. 460 and Fig. 461. This shows

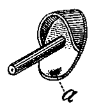


FIG. 460

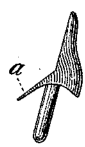


FIG. 461

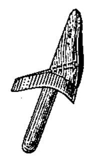


FIG. 462

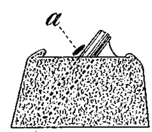


FIG. 463

that it was bearing heavily at the place so marked and touching nowhere else, thus bringing the entire strain of the force exerted in mastication on the facing at this point, with the inevitable result that the facing is broken, as there is no porcelain made which will withstand such a strain (Fig. 462).

This result may have been brought about by a slight deviation in the technic in any one of the several steps taken in the making of the outer cap. The first may have been in the soldering of the pin to the floor. In soldering, it must be remembered that the tendency of the molten solder is to flow into corners and angles, or between different pieces of metal which may be nearly, or quite, in contact with each other. In the drawings, which have been purposely somewhat exaggerated for the sake of illustration, will be found the explanation of the cause of the larger part of the trouble from broken facings in the anterior part of the mouth.

In Fig. 463 is shown the floor with the pin in position, invested and ready for soldering. As already stated, the solder is placed on the labial side of the pin and resting against the floor at point *a*, Fig. 463. If a large amount of solder has been used at this point, what is the result? The piece is highly heated, the solder is melted and naturally seeks the smallest space in which to lodge. It is thus drawn from the labial to the lingual side of the pin, almost the entire bulk filling in the narrow angle between the floor and the pin (Fig. 463). The result is that there being so great a bulk, as the solder cools, it contracts quite a little, changing the normal plane of the floor (*a a*, Fig. 464), drawing it up on the lingual and consequently depressing it on the labial side (Fig. 464, *b b*), with the result that the floor will touch the floor of the inner cap at this point, the labial side, and at no other.

It can readily be seen what the result would be if it were allowed to remain in this condition, and the facing attached. The trouble would have been obviated in the first place if only just enough solder had been used to attach the pin to the floor.

The second step, where the trouble may have occurred, is in the soldering of the half-band to the floor. In this, as in the previous case, only a minute portion of solder should be used, only sufficient to attach the half-band to the floor.

The pin, having been left long on the top of the floor and sloping well lingually, may come nearly or quite in contact with the upper edge of the half-band. If a large amount of solder is used in soldering this half-band, the solder will flow in between the pin (Fig. 465, *a*), and the floor of the cap and in cooling, as in the first step, contracts and changes the plane of the floor (Fig. 466).

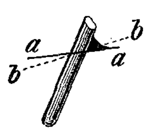


FIG. 464

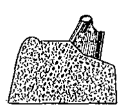


FIG. 465

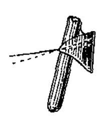


FIG. 466

If it is found that the labial side of the floor has been depressed, it should again be placed on the inner cap and the floor raised slightly, so as to be clear, before proceeding with the next operation.

The same thing may happen in the final soldering if the pin has been long, even if, in the previous operations, only a very small amount of solder has been used. The facings having been backed and the piece invested, the solder may bunch up and cool between the pin and the floor and so produce exactly the same results as in the previous cases.

The cap being completed, the pin should be cut off close to the floor of the cap before grinding the facing (Fig. 467). If this is done there will be no risk of trouble happening in the final soldering of the piece.

It should be remembered that the whole trouble is brought about through the contraction of the solder on cooling, and the effect

Fig. 467

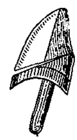


Fig. 468

of this should be carefully studied, not only in this, but in other operations, as it is something that will have to be contended with in all of our prothetic operations.

It is better that the floor of the outer cap should slightly clear the floor of the inner cap at the labial side, rather than to press heavily on it, because if the floors are not in actual contact at that point (Fig. 468), there will be little probability of the facing being broken, but if it rests heavily there, and at no other place, as in Fig. 462, one may count on the facings being broken about as fast as they can be put on.

When an accident of this kind occurs, and the floor is found to press heavily on the labial side, the bridge should be placed in the mouth and the outer floor lifted slightly off from the inner cap, so that it will clear it or touch it but very lightly, by passing a thin instrument, like a knife blade, between the two floors and raising the labial side of the outer one slightly. If this is done when the new facing has been replaced, there is little liability of its being fractured.

INLAY ABUTMENTS.

The inlay abutment is another form of anchorage which is useful for small bridges.

These attachments are especially indicated in the anterior part of the mouth where but a single tooth is to be replaced, such as a missing lateral or central, or a lateral and central incisor, both on the same side of the mouth and at times even where the four incisors are missing. They may be used in the cuspids and centrals. In the back of the mouth they are frequently indicated where a single bicuspid or molar, or molar and bicuspid is missing, or at times even the two bicuspids and molar. An inlay attachment may be used in the second molar, and in the cuspid where it is desired to preserve the crowns of these teeth for esthetic reasons. Frequently, where a molar crown is perfectly sound, but the tooth is perhaps somewhat ill-shaped, so that it would be almost impossible to prepare it and fit a band properly, it is better to use the inlay attachment.

An inlay abutment is composed of an inlay through which a tube is passed into the pulp chamber or pulp canal. Afterward a second inlay with a split pin attached is used as the bridge attachment.

In using these anchorages, it is always necessary to devitalize the teeth.

Inlays for Anterior Teeth.—In the making of these attachments, those for the anterior part of the mouth, the upper centrals or cuspids will first be considered, all of the lower incisors being too frail for such an anchorage.

The tooth having been devitalized, the upper third of the canal is carefully filled and the lingual surface of the crown cut away from the side to which the bridge is to be attached to about two-thirds of the distance across the crown, and extending down to the gingivæ, or near enough to it so that there will be room to allow of sufficient bulk to the inlay to give support to the bridge and at the same time afford a good occlusion (Fig. 469).

The cavity is shaped somewhat as shown in the illustrations (Figs. 469 and 470), being made non-retentive, and the enamel edges of the

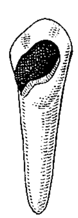


Fig. 469

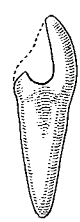


Fig. 470

cavity should be beveled so as to give more perfect margins. The canal is then enlarged for the reception of the tube. It should be noted that a larger tube can be used in an inlay abutment than could be used where the tooth is cut beneath the gum labially, as when using a porcelain crown or porcelain facing. The reason for this is that in the case of an inlay abutment the tube, starting as it does considerably above the gingival line, it is not necessary that it should go to a greater depth than about one-third or one-half the length of the root below the gingivæ, so that it occupies only the broadest and heaviest part of the root.

In the central incisor, a No. 4 tube may be used and at times even a No. 5. A No. 5 tube is generally indicated for the cuspids. The canal is enlarged somewhat lingually so as to give the tube a slope in that direction which will allow plenty of metal between it and the labial side of the cavity and permit of this being cut away for the reception of the second inlay.

The cavity is moistened and the tube with the mandrel in it is placed in the root and pressed well lingually so that it clears the incisal edge of the tooth by a good margin (Fig. 471). The cavity is then filled with wax, the wax being flowed in hot so that it will pass around the tube and become well attached to it. The cavity should be well filled and the wax carved so as to reproduce the natural contour of the lingual surface of the tooth.

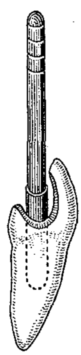


FIG. 471

It will be found on removing the inlay and replacing it again in the cavity that the shrinkage of the wax on cooling has opened the margins, especially at the gingival end. The wax should be trimmed lightly so as to enlarge this space a little and the inlay is then replaced and fresh wax flowed in the crevice.

The wax should then be smoothed flush with the sides of the tooth and a little more wax flowed over the margins so as to leave something of a feather edge, after which it is again removed from the tooth and prepared for casting.

The mandrel is grasped in the pin-vise and some of the wax carefully trimmed away from around the mouth of the tube where the cavity will be made for the second inlay, as shown in the illustration (Fig. 472), after which the mandrel is removed. This should be done very carefully so as not to mar or distort the inlay. The mandrel being held in the pin-vise, a sharp instrument is placed against the end of the tube and it is in this manner forced off from the mandrel. In removing it, it is well to hold it over a napkin or some soft material, so that should it drop from the mandrel there would be no danger of marring the edges.

The sprue wire is then attached to the lingual side at the point shown in the illustration (Fig. 473). The lower end of the tube is held in the pin-vise and the tube carefully filled with asbestos paper or material of a similar nature, so that in casting there will be no

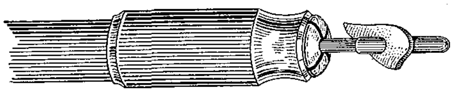


FIG. 472

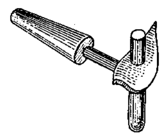


FIG. 473

possibility of any of the metal forcing its way into the tube. The inlay is then flasked and cast. For these inlays, the writer prefers pure gold as with it, much more perfect margins can be secured than is possible with any alloy. If they are carefully made, after setting, the pure gold inlay can be burnished and finished so as to entirely obliterate any line of cement.

The inlay having been cast, is removed from the investment and carefully cleaned, hydrofluoric acid being used to remove any traces of silica which may be clinging to its surface.

The asbestos paper is removed from the tube and the tube carefully cleansed and dried. It is then ready to form the cavity for the second inlay.

It should be placed in the mouth and articulated, enough of the gold being cut away so as to clear the occlusion, after which it is removed and the cavity is made for the second inlay. This is done before taking the final impression and articulation, as by making the cavity at this time it forms a seat which will be a guide when replacing it in the plaster impression after it has been removed from the mouth.

The cavity for the second inlay is shaped in the same manner as that for the first inlay, allowing a sufficient margin of gold to remain at all points to give the required strength to the attachment (Fig. 474). The cavity is smoothed so that there will be no sharp edges which will scrape the plaster, after which the inlay is replaced in the mouth, and the impression and articulation taken. After the impression has been removed from the mouth, the inlay is carefully replaced in it, and great care should be exercised to be certain that it goes exactly into its proper position.

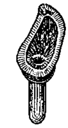


FIG. 474

It is then firmly fastened in place at two or three points at the margins with a little sticky wax, after which a thin film of paraffin and wax is placed around the tube. The whole inlay is then given a coating of cocoa-butter and the impression having been varnished, the model is made and articulated in the same manner as for an ordinary bridge.

After the model has been separated from the impression, the inlay is removed by heating it slightly and in this case it is better that the model should be thoroughly dried, and hardened, at least around the tooth which received the inlay. This can be done, after drying, by soaking it with thin sandarac varnish.

The finishing touches are now given to the inlay, by replacing it on the articulated model and grinding a little wherever necessary. The cavity in the inlay can readily be changed to suit the existing conditions. It should then be made perfectly smooth and the constriction at the neck of the tube removed with a flame-shaped bur, so that the mandrel over which the tube was made will enter freely. The finishing bur, Fig. 418, is best suited for this purpose. The entrance to the tube is rounded somewhat with the same bur.

The cavity can be smoothed ready for the pumice by using very fine carborundum stones, or dull finishing burs, those of the pear-shape, or rose-bur, being indicated, and if they are used wet, they will finish it much more smoothly than if they are dry. A sharp bur will not finish the cavity nearly as well as will a dull one, and the writer when in need of a bur for finishing purposes and having only new ones at hand, make it a custom to smooth them a little by running them over an Arkansas stone before using them on the inlay. After having been made smooth with the burs and being made perfectly symmetrical, the cavity is finished with pumice and rouge. This can best be done by using a wooden point in an engine port polisher and after roughening the point somewhat, wrapping a little cotton around it so that it will carry the smoothing and polishing powder.

The Fitting of the Split Pin.—The next step is to fit the split pin. The pin is made in the manner which will be described later, with the exception that it is made about twice the length of the tube, and the point of contact is also long, as shown in the illustration (Fig. 475), so that the point of union where the pin has been soldered will come, when it is finished, just below the floor of the cavity. It is carefully fitted to the tube and should fit it just about as easily as the pin should fit the tube for an anterior crown.

It is then annealed and placed in the tube and a mark made just at the entrance from the floor line at point *a*, Fig. 476. It is now removed and placed, the finished closed end first, in the pin-vise, carrying it in about one-thirty-second of an inch farther than the

FIG. 475

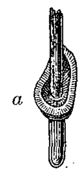


FIG. 476

mark showing the floor line. The vise should be tightened firmly and the pin bent over by pressing it against the edge of the bench, or by catching the end in a pair of pliers.

After bending it part way, it is best to re-anneal it before the bending is finished. The pin is then bent nearly at right angles or even farther so that it will follow the general direction of the cavity (Fig. 477).

The pin should be bent in the direction of the split, as if it is bent across the split, should it be held in the pin-vise very close to

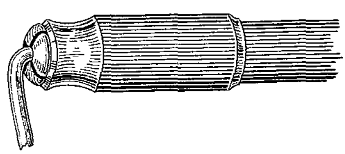


FIG. 477

the soldered point of union, there is a possibility of breaking this union and one of the halves sliding upon the other and thus destroying the fit of the pin.

The pin, having been bent to its proper shape, is filed open at the end, care being taken to file it in the direction of the split and the end is nicely rounded. Every thing is now ready for the making of the second inlay.

The Second Inlay.—The second inlay should be made of a harder metal than the first, such as coin gold, or some alloy equally hard and which fuses at about the same temperature as does the coin gold.

The second inlay may be made by inserting the pin in the tube, building it up with wax and casting, but this will not make as perfect an inlay as can be made in the manner described below, but it can be used if desired.

The method which the writer prefers in making a second inlay is to first burnish a pure gold matrix into the cavity and afterward fill the matrix with coin. The pure gold should be of about No. 36 gauge, great care being used in the burnishing to have the margins as nearly perfect as possible. It should be annealed very frequently during the operations and worked in very slowly, as in a cavity of this kind, if the metal becomes the least bit hard from burnishing, it is easily cracked.

After the matrix has been burnished in, a hole is made over the entrance to the tube, so that the pin will pass through the matrix and enter the tube freely. This having been done and the pin and matrix having been removed, the cavity and entrance to the tube are given a light coating of cocoa-butter. The matrix is then annealed and it and the pin placed in position, the edges of the pure gold extending beyond the sides of the cavity, and the cavity is filled with a hard, sticky wax. The wax should be run in hot so that it will pass all around and under the pin, and after it has been chilled it should be pressed tightly down around the pin and over the margins, forcing the pure gold matrix in close contact with the edges of the cavity. It is then removed and is ready for investment.

It is invested as shown in Fig. 478, and only a sufficient amount of the investment used to hold the parts in position. The over-

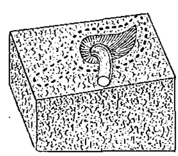


FIG. 478

lapping edges of the matrix should be covered, but the investment should not be carried over the cavity margins. It is then heated-up to a red heat.

A button of coin gold of sufficient size to fill the matrix should then be made and laid over the pin, the whole heated up well and the button melted into the matrix so that it will fill it a little more than flush, the same as in filling a cusp, after which the inlay is removed from the investment and well cleansed in acid.

It is then dried, replaced in the inner inlay and finished. It should be ground perfectly flush with the margins and from the second inlay to the outer edges until it is finished and properly contoured. It should be remembered that the cutting should be from the center outward (Fig. 479), as if it were ground in the opposite direction, the gold in the outer inlay would be burnished over the second inlay so that it would be impossible to separate them. It is now ready for attachment to the bridge.

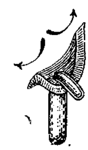


Fig. 479

This work is done on the model and after all of the parts of the bridge are assembled they are waxed together, care being taken to wax it thoroughly to the extending pin of the inlay. The piece is chilled and the inner inlay removed from the outer by grasping the tube and pressing against the pin with a fine-pointed instrument or the edge of a knife blade exercising great care not to use force at any other point, otherwise the relation of the bridge and inlay might be disturbed.

Before investing it for the final soldering, the inlay should be coated well with antiflux (common whiting will answer for this purpose), which will prevent the solder from flowing over the margins and destroying the fit of the inlay. In finishing the piece, great care should be exercised not to polish the pin or the inside of the inlay. An old tube placed over the pin during the finishing of the bridge will prevent any injury to it.

Inlays for Molars.—The cavities for the inlays for molars should be large and take in a good part of the occlusal surface (Fig. 480) extending on the side to which the bridge is to be attached down to near the gingivæ, as shown in the illustration (Figs. 481 and 482).

Fig. 480

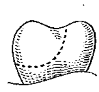


Fig. 481

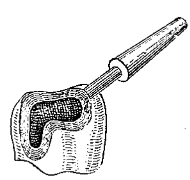


Fig. 482

The cavity is made non-retentive, and if there should be any undercuts, they may be filled in temporarily with gutta-percha or cement.

The tubes for the molars should extend to the floor of the pulp chamber and occasionally it may be necessary to deepen it on the mesial side, letting it drop into the root a short distance, as in the case of a telescope crown with a tube and split pin.

It is desirable in these cases that pure gold should be used next to the tooth structure so that a more perfect margin may be obtained. As a general rule the pure gold should be about one-thirty-second of an inch in thickness, and this will serve as a matrix for the making of the main body of the inlay. A very thin piece of wax, the pink paraffin and wax will answer nicely, and can be readily worked into the cavity, covering the margins perfectly. The sprue wire is attached to the distal end of the wax matrix (Fig. 482), which is then removed (Fig. 483), flasked and cast in pure gold in the same manner as an ordinary inlay. It has been the general custom of the writer, however, to do this by the indirect method, obtaining an impression of the cavity and then making an amalgam die over which to make the inlay.

The die having been prepared, the wax matrix is made of the desired thickness and fitted in the tooth before casting, being pressed

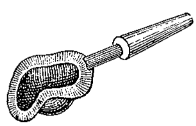


Fig. 483

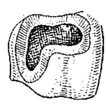


Fig. 484

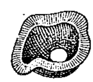


Fig. 485

firmly against the margins. The matrix need not extend entirely to the bottom of the cavity as it is only necessary that perfect margins be obtained, and that it be of sufficient depth to give body to the inlay, as in Fig. 484.

The matrix having been cast in pure gold, it is fitted in the tooth and the edges tapped in place with a stick of cottonwood so as to make sure that the edges are in perfect contact with the margins of the cavity. A hole is then made through the floor of the matrix over the point at which the tube will rest (Fig. 485). This hole should be considerably larger than the diameter of the tube, which is to be used. Pink paraffin and wax is then pressed through the opening to the bottom of the cavity in the tooth and pressed in over the floor of the matrix so that it will be firmly attached (Fig. 486). The impression and articulation is then taken.

The impression having been removed from the mouth, the gold matrix is removed from the tooth, great care being taken not to disturb the wax. This is replaced in the impression and caught at two or three points with sticky wax so that it cannot shift its position. The impression is then varnished and the underside of the inlay given a light coating of cocoa-butter and the model is prepared. After it has been separated, the inlay and wax are removed and the model dried and hardened. The inlay is replaced on the model, the wax which was beneath it having given a perfect reproduction of the shape of the cavity.

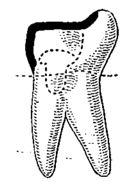


Fig. 486

The inside of the matrix should now be coated very lightly with cocoa-butter so that the wax will draw easily. The tube, with the mandrel inserted, is then placed in the cavity extending through the opening in the matrix to the floor of the pulp chamber or the bottom of the cavity which has been made to receive it, and the inside of the matrix filled with inlay wax, running it in hot so that it will attach itself to the tube (Fig. 487).

The tube resting on the floor of the pulp chamber can be made parallel with the anterior abutment by leaving the mandrel in any direction desired, the bottom of the tube remaining immovable at the bottom of the pulp chamber or cavity (Fig. 487).

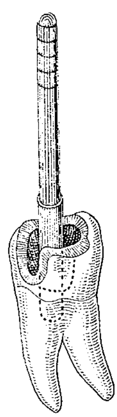


Fig. 487

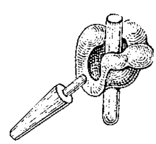


Fig. 488

The wax should then be cut away from around the top of the tube, roughly shaping the cavity for the final inlay and the sprue wire attached on the mesial side, as in Fig. 488.

It is then removed from the pure gold matrix and the mandrel removed from the tube which is packed with asbestos paper in the manner previously described. It is next flasked and cast with coin gold, after which it is well cleansed in hydrofluoric acid. After cleaning and drying, it is placed in the pure gold matrix in order to ascertain that it fits perfectly. The underside of the matrix is covered with whiting so that no solder will flow over and destroy the fit in the tooth and the two are united with 21-carat solder, the solder being placed at some point between the pure gold matrix and the coin, as at point *a* in Fig. 489, and drawn through entirely from that point until the pure gold and coin are perfectly united. The cavity is now ready to be prepared for the final inlay.

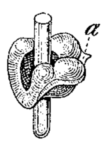


FIG. 489

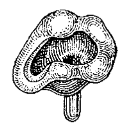


FIG. 490

The tube is cut off to the floor of the cavity and the coin gold cut away, making the cavity a little larger around the tube, giving it something the shape of a key-hole, looking from the occlusal surface, so that it will not be necessary to depend entirely upon the split pin for retention (Fig. 490).

The cavity is finished so that it is perfectly symmetrical in shape and then polished, the entrance to the tube having been opened so that the mandrel over which it was made will enter freely. The pure gold matrix is burnished in place, the pin fitted to it and the inlay completed in the manner already described in the making of the anterior abutments.

Before cementing the inlay in place, any gutta-percha or cement which has been placed in the tooth to obliterate undercuts, should be removed in order that the inlay may become firmly attached with cement.

It is an advantage to have the bridge worn for from twenty-four to forty-eight hours without cementing in order to allow for the settling of the piece, and for the abutments to accommodate themselves to it. Where there is an inlay abutment such as the one just described, the inlay is always set separately, as there is only one way in which an inlay can go into place and it must go to its proper place or it will stand away from the margins of the cavity at one point or another with the result that the cement will wash out and decay take place.

After it has been carefully articulated, finished and cemented, the edges of the pure gold matrix are burnished over the edges of the cavity and it is polished finally. In this way more perfect margins may be secured.

Inlays by the Matrix Method.—In the absence of casting machines, inlays may be made by the matrix method so that *they will be* as perfect as those made by casting. The cavities are prepared in the manner already described. A matrix of pure gold, as heavy as can be worked into the cavity, is then burnished into place, or a very thin platinum matrix may be used, burnishing it in the same manner as for a porcelain inlay. The matrix must be carried over the cavity margins and made as perfect as possible (Fig. 491).

The matrix is then annealed and put back in the tooth, the tube placed in position (Fig. 491) and waxed well with hard sticky wax, filling the matrix to the cavity margins. When the wax has cooled, it is packed tightly in place around the margins of the cavity so as to press the matrix in perfect contact. The matrix is then removed and the tube filled with asbestos paper or fiber, and the whole invested (Fig 492).

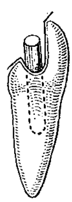


Fig. 491

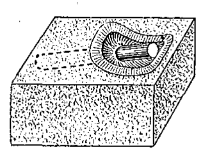


Fig. 492

If a pure gold matrix has been used, the matrix should be filled with coin gold, but if the matrix has been of platinum, then it can be filled with pure gold. After cleansing it is dried out and the cavity prepared for the second inlay, the technic in this case being exactly the same as for the cast inlays, which has already been described.

In very small pieces, or in the anterior part of the mouth, where the teeth are small, the second inlay may be done away with by fitting and bending the pin so that it will rest in the bottom of a groove which has been made to receive it (Fig. 493). The groove should be made the size of the split pin which is to be used and after it is completed, the extending end of the pin should be soldered into the bridge. This will answer the purpose and do as well in carrying a small bridge as if there were a second inlay, but it does not make quite as clean a piece, as there will be a groove on

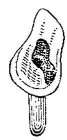


FIG. 493

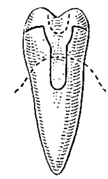


FIG. 494

either side of the pin as it rests in the inlay. Neither is it quite as strong, and where strength and rigidity are desired the double inlay should be used.

Inlay abutments may sometimes be used in the lower bicuspids, especially if they are made so as to restore a part or the whole of the occlusal surface of the tooth, in which case the tooth is beveled from the inside outward and downward toward the gum, as is Fig. 494, and, as will be seen, there is practically no possibility of the tooth being fractured by the pressure. In the upper bicuspids, however, the inlay is very rarely indicated, as the crowns of these teeth are never very strong and very little force would be required to bring about their fracture.

SUPPORTING ABUTMENTS.

The anchorages so far described have been retaining abutments and the supporting abutments will now be considered. As previously stated, the supporting abutment gives support against vertical and lateral stress and has nothing to do with the retention of the bridge.

Supporting abutments may be in the form of gold fillings or of inlays, the gold fillings being countersunk to receive the spur. A hooked spur of platinized gold or iridio-platinum resting in a countersunk gold filling or an inlay forms an excellent support for one end of a bridge. This is especially the case in the lower jaw, where it will safely support one end of a bridge consisting of two or three or even more teeth and having but a single retaining abutment.

In the upper jaw, with a crown carrying a single dummy, the other end may be supported by a spur in countersunk filling or an inlay. They are often useful, too, in giving extra stability to a larger bridge which has two or more retaining abutments, but which may require some additional support.

Gold Fillings.—Where a spur is to rest in a filling in any of the anterior teeth, either upper or lower, the cavity is made in the palatal or lingual side of the tooth and also extending for a distance over the side next to the bridge, as in Fig. 495. Where the bite does not interfere, the cavity is made just at the basilar ridge where the enamel is very thick, and should be of good size, approximately about one-eighth of an inch in diameter.

The cavity should be started with a small carborundum wheel, plenty of water being used to cut through the enamel and give the general outline to it, before putting on the rubber dam. The rubber dam having been adjusted, the cavity is deepened with burs as much as possible without endangering the pulp. The cavity is well undercut and a filling of hard gold, thoroughly condensed, is inserted. It is made large enough so that the contour

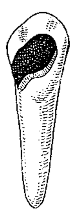


Fig. 495

Fig. 496

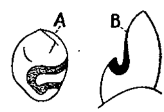


Fig. 497

of the tooth is somewhat exaggerated, as in Fig. 496, but not enough to interfere with the articulation.

The filling is then polished and a hole drilled in the center of it on the palatal side to within a short distance of the bottom of the cavity, the base of the hole being shaped with a bud-shaped bur about the size of the No. 14 to 16 gauge wire of which the spur will be made. A groove of the same size is then cut from this opening to the distal side of the filling, care being taken to allow a strong body of gold remain underneath and around it so as not to weaken the filling (Fig. 497, *a b*).

Before taking the impression, a small amount of pink wax is pointed and pressed into the bottom of the cavity and into the groove, and the impression taken in plaster in the ordinary manner. When the impression is removed from the mouth, the pink wax will come away with it, giving a perfect impression of the cavity and groove in the filling. If the impression is taken without the wax, the fine point of plaster extending to the bottom of the cavity will be broken away and will not give a perfect impression in the model. The model is then made and after it has been trimmed and hardened, the fitting of the spur and the balance of the work is done on it.

The Inlay as a Support.—In using a gold inlay as a support for the spur, the operation is simplified, and the spur can be made of any shape desired with a certainty of its fitting the cavity properly. A slight notch or groove is made in the tooth, before taking the impression, where it is desired that the spur should rest, in order that the position on the model which the spur is to occupy may be located. The spur may be in the form of a hook, especially in the anterior part of the mouth (Fig. 498), or in the form of a dovetail

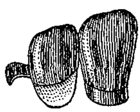


FIG. 498

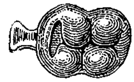


FIG. 499

(Fig. 499). The latter is especially applicable in the case of the molars where greater strength is required.

The object in making the spur in the shape of a hook or dovetail rather than having it straight and flat, is that it may bind the teeth together so that there is no possibility of their spreading, which might happen should there be a smooth piece of wire resting in a groove.

The plaster tooth is cut away sufficiently, at the point indicated by the notch or groove, to allow for the resting of the spur, and the bridge is constructed with the spur made so as to rest in the cavity. When the bridge is completed, the natural tooth is cut away roughly, where the spur is to rest, so as to allow the bridge to drop into its proper position. It is well to allow the patient to wear the bridge for a day or two before cementing.

When the bridge, if it be removable, has been cemented, and the cement thoroughly hardened, it is removed from the mouth and the making of the inlay undertaken. The cavity for the spur is enlarged sufficiently to allow of a good bulk of gold on all sides, extending well down on the approximal side of the tooth. On this side the cavity can be made very shallow, as there is no strain here and the gold over this surface is simply to protect the tooth from decay, which is very necessary in the case of fixed bridges, but not so important where the bridge is removable.

The sides of the cavity should be made as nearly parallel as possible, but it must be made non-retentive. The wax is then placed in the cavity and the bridge slightly warmed and placed in position, the spur pressing its way into the wax. The wax is then trimmed to the margins of the cavity. The bridge is removed and replaced several times in order to be positive that the spur has made a good seat.

The sprue wire is then fastened to the wax, which is removed from the tooth, invested and cast, either with pure gold or an alloy. After it has been cast and cleansed, it is first tried in the cavity and the bridge is adjusted to it. It is then removed, the sides roughened, the cavity undercut slightly, and the inlay cemented. After the cement has thoroughly set, the inlay is carefully polished and the bridge placed in the mouth. In the case of a fixed bridge, the inlay is prepared before the final cementing.

By making the inlay in the manner described, it is certain that the spur is perfectly seated, which is not always the case where the gold filling has been used as a rest.

CHAPTER XIII.

TUBES AND SPLIT PINS.

AMONG the most important accessories in removable bridge-work are the tubes and split pins. In order that they be effective, it is necessary that they should be made with the greatest accuracy. The tubes should be perfectly round and smooth on the inside and the split pins, which are to be used in them, should be made so as to fit perfectly, otherwise they will be of but little value.

The metal of which the tubes are made should be hard, tough, rigid and non-oxidizable. The best alloy for the purpose is iridio-platinum, the alloy containing approximately 10 per cent. of iridium. If the dentist is specializing in bridge-work, or is doing a large amount of it, it would perhaps be better and cheaper to have the tubing made by a platinum manufacturer who makes a specialty of work of this character. Should this not be the case, the tubes may easily be made by the operator. When the writer first began the making of removable bridge-work, he made his tubes by drilling a solid iridium-platinum wire with a twist drill of suitable size on a jewler's lathe. It developed, however, that a drilled tube was not a good tube. It makes little difference how sharp the drill may be, or how smoothly it cuts, the tube will always be rough on the inside, the drill leaving a minute thread which, no matter how fine it may be, will wear down quickly, and entirely destroy the fit of the pin in the tube. Tubes may be made with a draw plate, but a drawn tube is never perfectly straight, and before using them, it is necessary to drive a mandrel through in order to straighten them.

Making Tubes by the Mandrel Process.—A simple and easy method of making a good tube and one which the writer has largely employed for a number of years, consists of working them over steel rods or mandrels made for the purpose and is as follows:

The Mandrels.—The set consists of six mandrels made from regular sizes of Stubb's steel wire, which can be procured at dealers in machinists' and jewelers' supplies. The gauge numbers run from 48 to 53 inclusive, the sizes of the wire being, respectively, .075, .072, .069, .066, .063 and .058 of an inch in diameter.

These rods are cut in lengths of about one and one-half inches, and the ends carefully rounded. For convenience, they may be numbered from one to six, by marking them with rings around one end, according to the size of the mandrel, beginning with the smallest, Nos. 1, 2, 3, 4, etc. (Fig. 500).

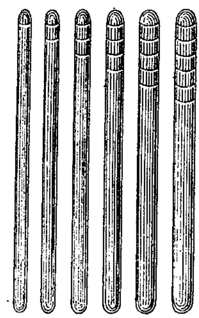


Fig. 500

In tempering the mandrels, they should be heated to a cherry red (it is best to heat them on a charcoal block), and then plunged in water to harden them. In plunging them in the water, they should be grasped with the pliers by one end so that they will hang vertically and enter the water in this position. If they are plunged in sideways, so that one side of the mandrel becomes chilled before the other, they are more apt to be sprung or distorted.

They are then dried off and polished with cuttlefish or other very fine grit paper. The heating and chilling having made them extremely hard and brittle, it will be necessary to soften them somewhat to prevent their breaking, which may be done preferably by laying the mandrels on a piece of heated metal until they assume a color indicating the desired temper, when they should be again plunged into cold water endwise. The mandrels should be of a high spring temper and should be drawn down until the color is between a deep straw and a pigeon blue. This gives them the right degree of hardness, after which they may again be polished, or they can be used without polishing.

It is a good plan when the mandrels are first heated up, before they become red, to plunge them into a cake of soap and then proceed to heat them up to a cherry red. This will prevent oxidation of the metal, and they will come out cleaner than they otherwise would.

Another method of procedure for the beginner, or for those not familiar with tempering steel, and which will perhaps answer the purpose for which the mandrels are intended, is to bring them to a cherry-red heat and then plunge them into a heavy oil. They are next held in the flame of an alcohol lamp or a Bunsen burner until the oil is burned off, and then plunged into water. This will soften the mandrels so that they will have a fair spring temper. After the oil is burnt off, they should be carefully smoothed and polished.

The Tubes.—The material of which the tube is to be made, iridio-platinum plate, containing about from 7 per cent. to 10 per cent. iridium and of No. 32 gauge or .008 of an inch in thickness. If the plate is about seven-sixteenths of an inch wide, it will be of sufficient width to give ample length for any tube that may be required. The strip should be cut lengthwise with the grain of the metal as it has passed through the rolling mill.

In making the tube, the plate is first annealed, the end squared, and beveled with a fine file to a knife edge (Fig. 501). A hammer-

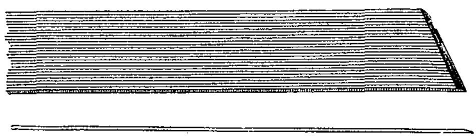


Fig. 501

headed hand-vise is necessary in making the tubes, as it is very strong, and the jaws open and close on perfectly parallel lines (Fig. 502). The serrations should be ground off so as to leave the

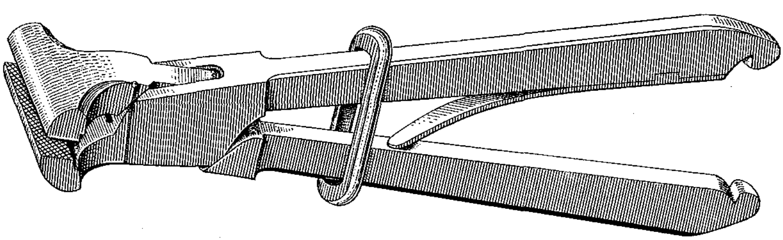


Fig. 502

jaws perfectly smooth on the inside, and the outer edge of one of the jaws should be slightly rounded. The end of the iridio-platinum plate is grasped in the jaws of the hand-vise and bent slightly upward, the beveled edge being underneath (Fig. 503).

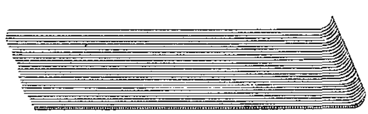


Fig. 503

The mandrel is then laid across the iridio-platinum plate, the turned up edge of the plate preventing it from rolling off. It is now grasped by the hammer headed hand-vise, one jaw engaging the mandrel and the other the upturned edge of the plate (Fig. 504). The plate is then bent around the mandrel, as shown in the illus-

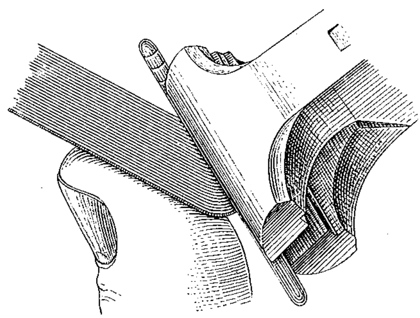


FIG. 504

tration, until the beveled edge has passed the center of the mandrel, so that it will not drop out if it is raised above the level of the opposite end (Fig. 505).

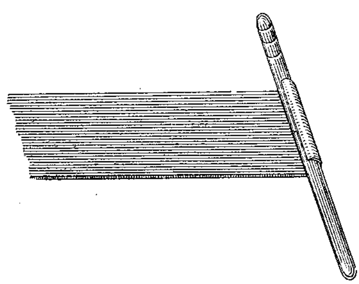


FIG. 505

The plate, with the mandrel in position, is next laid on a flat hard surface, such as the face of the anvil, or on a flat, smooth file. The end of a flat course file, say a No. 2 cut, is held in such a position as to catch the beveled edge of the platinum. The other end of the plate is held tightly with the fingers of the left hand and the file pressed downward and backward against the mandrel, as is shown in Fig. 506, the plate being rolled around it until the beveled edge is in contact with the lower side of the plate, as shown in the illustration (Fig. 507). It is very important that it should be rolled only until the beveled edge is exactly in contact with the plate, for the following reasons: It is desirable to use as large a tube or pin in a tooth as the root will permit, the difference in

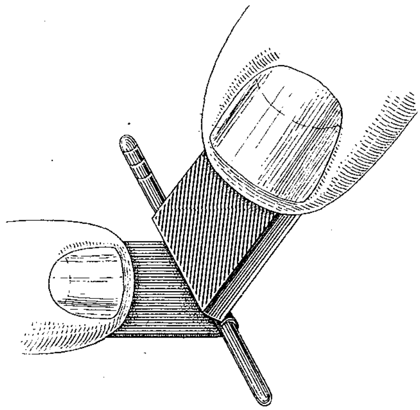


FIG. 506

the size of the mandrels is .003 of an inch, with the exception of that between the first and second, in which the difference is .005 of an inch. The plate used for making the tubes is of No. 32 gauge, or .008 of an inch in thickness. If in rolling the tubes, the lap is carried beyond the point of contact, as shown in Fig. 508,

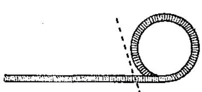


FIG. 507

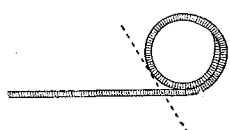


FIG. 508

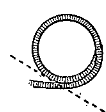


FIG. 509

there will be an extra thickness of metal on that side. It can readily be seen that this extra thickness of metal will give an outside diameter of the tube that will be .008 of an inch greater than it would were it brought exactly in contact with the beveled edge (Fig. 509). The result would be that the hole in the root would have to be made as large to accommodate a tube so made as though it were intended to use a much larger tube, being 0.008 of an inch larger or nearly the difference in size between three mandrels. In other words, if this extra lap is made it would be necessary to have an opening in the root for a tube made over a No. 2 mandrel, as large as would be required for one which had been properly made and finished over a No. 5 mandrel.

The tube having been rolled in the proper manner, the mandrel is removed and the seam soldered with pure gold, no flux being used. A small piece of pure gold is laid on the plate, being in contact with the plate and lower side of the tube (Fig. 510). It is then

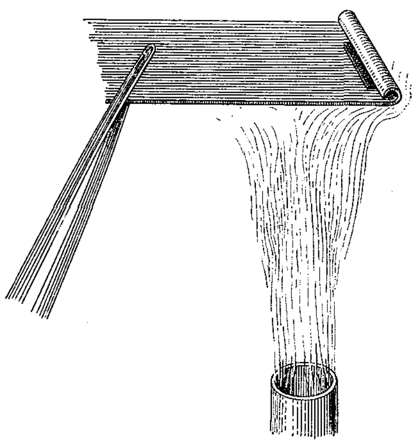


FIG. 510

soldered by holding it over a flame of a Bunsen burner, first passing it through the flame so that it will strike the plate a short distance from the tube, and holding it there until the gold begins to melt. The tube is then drawn back into the flame and held until the gold is thoroughly melted, the tube is soldered all the way across, and the gold is well burned into the platinum.

If the tube is first held in the flame, it will be found that as the pure gold solder melts, it will jump up over the side and around the top of the tube, but will not unite it at the lap. It is cooled by laying it on a cool surface, such as a file or an anvil. This will take but a moment. It should never be cooled in water, as should this be done, when another mandrel is driven through it, the tube being moist will cause the mandrel to rust and it will be ruined after having been used but a few times.

The next step is to take the mandrel of the next size larger than the one over which the tube was first rolled and drive it through the tube, having the tube facing toward the operator and the surplus plate extending to the right. The end of the tube is placed on the anvil and the mandrel driven through it by tapping with a light hammer until it comes in contact with the anvil (Fig. 511).

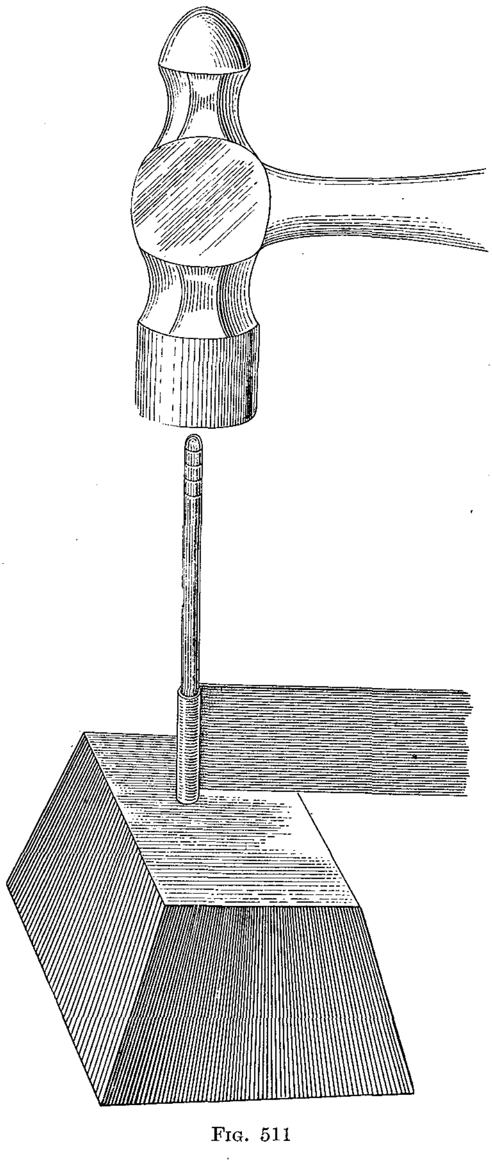


Fig. 511

The mandrel is then grasped in a pin-vise and the surplus metal trimmed away as close to the tube as possible (Fig. 512).

The mandrel being driven through in this manner, with the lap to the right, allows the flat side of the scissors to be placed against the tube and thus cut close to it. The lap is then filed perfectly smooth and flush with the sides of the tube (Fig. 512, *a a*), so that in rotating it between the fingers, no unevenness is felt. If a ridge is felt along the side, it should be filed off carefully so that the diameter is no greater at that point than at any other.

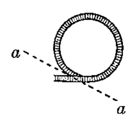


FIG. 512

The end of the tube is then bent over the rounded end of the mandrel by pressing it and working it over with the side of a smooth, flat file, until it is partially closed (Fig. 513). The stretching of the tube over the mandrel will necessarily make it fit so tightly

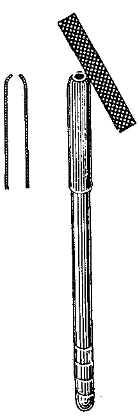


FIG. 513

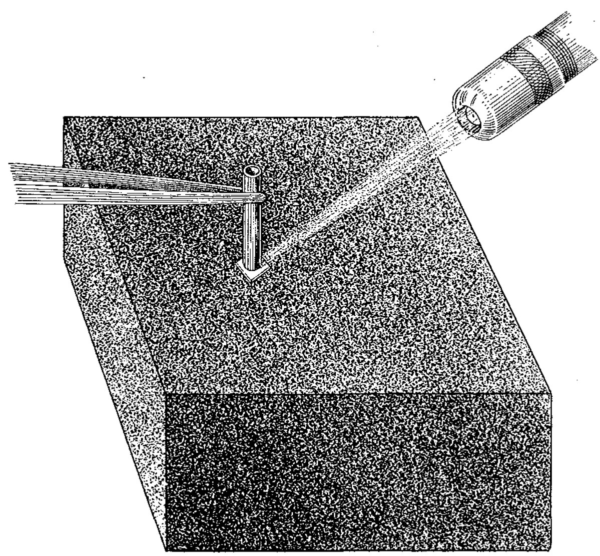


FIG. 514

that it cannot be pulled off, but by rolling it a little under a smooth file on the anvil, with a little pressure the metal will be stretched sufficiently to allow of the mandrel being removed.

A small square of the same metal of which the tube is made is then placed on the charcoal block and a small piece of pure gold melted on its surface. The tube is grasped in a pair of pliers, the partially closed end being down and resting on the square of the platinum (Fig. 514). The small blue flame of the blow-pipe is applied and as the pure gold melts and catches the tube to the floor it should be lifted slightly from the charcoal block so as to allow a flame to pass underneath the floor until the pure gold solder has flowed all around, perfectly uniting the tube to the floor. The mandrel is again driven into the tube and placed in the pin-vise, which grasps the end of the tube, the surplus metal of the floor is cut away and the edges filed flush with the sides of the tube and the end slightly rounded.

When speaking of the size or the number of the tube, the size of the mandrel over which the tube was finished is indicated. Thus a No. 4 tube was first rolled around a No. 3 mandrel and finished on a No. 4.

The No. 1 and No. 2 tubes are indicated in the teeth having smaller roots, such as the upper laterals and bicuspids, the No. 2 and No. 3 for the upper centrals and lower bicuspids, the No. 3 and No. 4 for the upper centrals and upper and lower cuspids and No. 5 and No. 6 for the molars.

SPLIT PINS.

The split pin, in order to be effective, must be made of a high fusing, elastic material and rigid enough to withstand the strain to which it will be subjected, and must be an alloy which will retain its elasticity even after being subjected to a very high heat.

There should be no loss of metal between the halves to weaken it in the least, and it should have practically the same amount of material in it as though it were a solid pin. The solid pin, which has been sawn through the center in order to produce a split pin, is worthless, so far as the lasting qualities of the pin goes, for the reason that a saw cut made through the center of the metal, has cut it away at its strongest part and rendered it very weak (Fig. 515). Half-round wire is the best material for making split pins and securing a maximum amount of strength (Fig. 516). For this purpose, platinized gold or clasp wire is the best.

Iridio-platinum Wire.—Iridio-platinum wire, while it may be a tougher and more rigid alloy than the clasp wire, does not seem suitable for split pins. The writer did considerable experimenting with this metal, covering a period of two or three years. At first it seemed as though this was the metal best suited for the making of split pins. After a time, however, bridges in which these pins had been used began to be brought to him with the pins broken

FIG. 515

FIG. 516

close up to the caps and they were replaced with platinized gold wire. It seemed that the constant springing brought about a recrystallization of the metal which rendered it very brittle. It would break with a clean sharp fracture, showing a very fine grain which presented the appearance of fractured hardened steel as of a broken needle. This result followed in almost every case where the iridio-platinum had been used, so that its use was finally discontinued.

Platinized Gold or Clasp Wire.—Of the various makes of gold and platinum alloys, known as platinized gold or clasp wire, which can be procured from the different dental supply houses, very few are at all suitable for split pins. The majority are too soft, or become so after being subjected to a high heat, and they also have too low a fusing point, very few of them standing a higher heat than that required to melt 18-carat solder. When the heat is raised above this point, the metal loses its elasticity and is apt to be fused together.

For many years there was only one manufacturer which produced a clasp wire which was suitable for this purpose. Within the past few years, however, other manufacturers have taken the matter up and it is now possible to secure other makes of high-fusing and high-grade metal which can be used. It should have a melting point above that of coin gold, and it should be possible to use this alloy as a solder for it without the slightest tendency to fuse, and without any loss of elasticity.

During a series of experiments the idea of sweating the halves together was tried, but the process proved a failure. In sweating the parts together, the whole mass of metal was heated nearly to the melting point of the alloy but this high heat brought about a molecular change which rendered the metal practically the same as cast gold, with the result that the pins became quite brittle and were broken in a comparatively short time, necessitating the replacing of them in nearly every instance where they had been used.

The size of the half-round wire used in making the pins for the different sized tubes, will run from about No. 12 to No. 14, inclusive. The wire of which the pin is to be made should, when brought together, be of a slightly greater diameter than that of the inside of the tube, thus giving an excess sufficient to allow for turning or filing them to fit the tubes. The No. 14-gauge wire can be used for the No. 1 tube, and sometimes for the No. 2, the No. 13-gauge for the No. 3 and No. 4 and No. 12-gauge for the No. 5 and No. 6. The measurement should be taken from the bottom of the tube to the floor of the cap and the wire should be bent about one-eighth of an inch longer so that the pin when completed will stand that distance above the floor.

Fig. 517

The half round wire is well annealed and is then bent on itself, the flat side innermost, as in the illustration (Fig. 517). It is then again annealed and bent still further over, bringing the end in contact with the flat surface of the wire. It is now grasped in a pair of pliers, at point *a*, Fig. 518, and held in the flame of a Bunsen burner until it reaches a red heat. The ends are brought together and held until it is chilled slightly, thus removing the spring and bringing the ends in contact for about one-eighth of an inch. The contact should be long enough so that when it is soldered and the pin completed, the soldered portion will come beneath the floor of the cap. The pin and the point of contact is longer in the case of an inlay and tube and split pin, as already described.

The part in contact is then fluxed and a small piece of coin gold placed on the flat side of the wire in contact with the overlapping end, point *b*, Fig. 518, and the coin gold melted with the blowpipe and drawn through sufficiently to unite it. Care should be taken not to use an excess of the coin gold as solder, as by so doing the pin may be very materially weakened. If a large amount of solder has been used, it will draw through into the loop, leaving a large bulk of the gold extending beyond the point of contact (Fig. 519, *a*). The result is that when this is hammered or forged down, so that the two sides of the pin are in contact, the large bulk of the coin gold has been hammered into the sides of the platinized gold wire, so that both sides are partially cut through, as in Fig. 520. This will, of course, weaken the pin at this point and it will very easily be broken.

After this pin has been soldered, the extending wire is grasped in the pin-vise and the sides of the pin hammered together, bring-

FIG. 518

FIG. 519

ing the two halves in contact. During the hammering or forging the pin must be kept rotating, thus forging it round as the halves are gradually brought into contact. If the two halves are hammered together without rotating, it will be found that the sides have been flattened, thus making the diameter of the pin in this direction much less than in the direction of the split (Fig. 521). This will render it much more difficult, in fact it will be almost impossible, to make the pin perfectly round, whereas, by rotating it, the halves are brought in contact, at the same time forging it into the desired shape so that there will be little trouble in making the pin fit the tube. After forging, the pin should be annealed.

FIG. 520

FIG. 521

Filing of the Pins.—Filing is an art. There may be some who will doubt this statement, but it is true nevertheless. To learn to use a file properly requires a great deal of practice and some natural ability, and before undertaking to fit the pin to a tube, considerable time should be devoted to working with the file. Of as great importance as the proper use of the file is the proper method of using the pin-vise, and the dentist should learn to rotate the pin-vise properly.

The best pin-vise to use for the purpose is one which is perfectly round, and which has no set screws, but has jaws of the nature of a chuck which will grasp the pin and hold it in line with the pin-vise. The one shown in the illustration (Fig. 522) is the best which can be procured for all work of this character.

The pin is grasped by the soldered end in the pin-vise, catching it only far enough down to get a strong hold. The pin-vise is held lightly in the fingers of the left hand, the end of the thumb resting

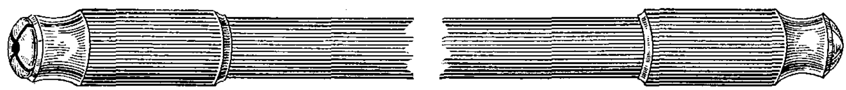


FIG. 522

on the top of the pin-vise and the pin on the filing block, as shown in the illustration (Fig. 523).

The file used for roughing down should be of two or three cut, flat, and about five inches in length, and should be held in the right hand very lightly, the forefinger resting on the face of the file, and over the middle of the pin extending from the pin-vise

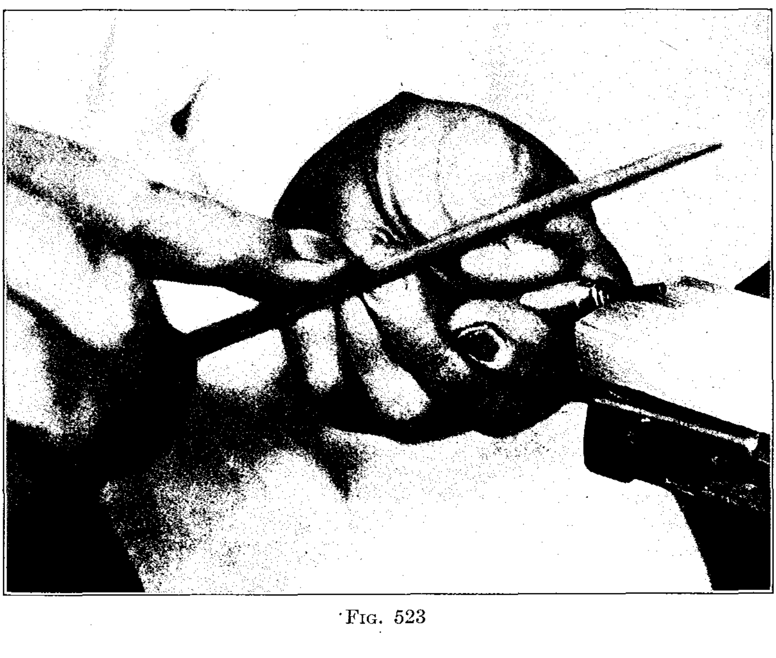


FIG. 523

(Fig. 524). The pin-vise is then rotated to the right with the thumb and fingers of the left hand. The file is passed lightly over the pin in the opposite direction, very little pressure being used, not much more than the weight of the file itself. The file should be moved only while the pin is rotating, being pushed forward over the pin and lifted from it while the pin-vise is still in motion. If this should not be done, and when the pin has stopped revolving, the file should be still pushed forward, a flat surface would be produced at that point. As previously stated, the finger should rest over the middle of the pin which perhaps extends one-half or two-thirds of the way across the file (Fig. 524). If the finger is held at the outer

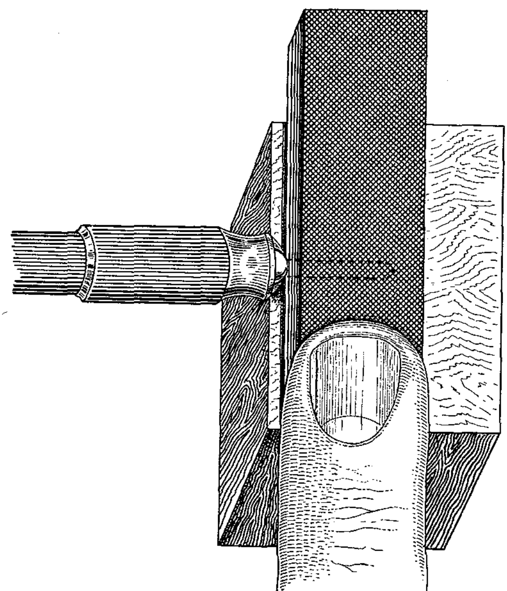


Fig. 524

edge of the file, there will be a greater pressure at this end of the pin than there should be, with the result that the pin will be made smaller at the outer end and the sides will not be parallel (Fig. 525).

If a very short pin is being filed, the finger should rest at the extreme inside edge of the file. The file should not be grasped as would be a baseball bat. If the file is held in the hand very firmly, the delicate sense of touch is lost and unconsciously a greater pressure is placed on one or the other end of the pin, with the result that it cannot be made of a uniform diameter throughout its length. When the file is held very lightly, so that it will move

19

freely with the slightest pressure of the forefinger, it will find its own level and keep the sides of the pin parallel from one end to the other.

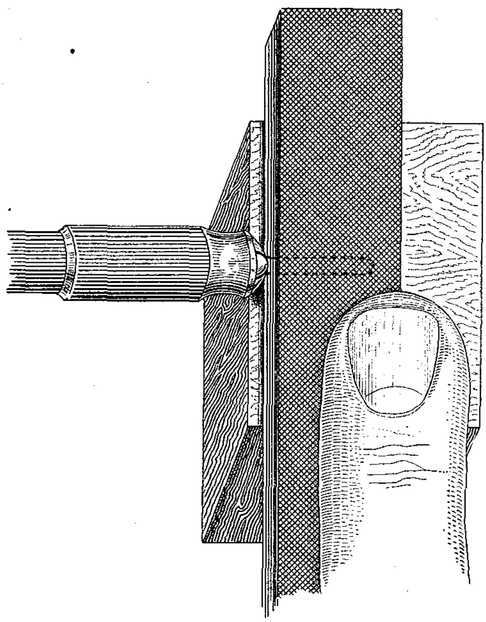


FIG. 525

When the pin has been roughed down with the coarse file to nearly the size that is desired, the final fitting and polishing should be done with the finest file that can be procured and afterward it is burnished. For the final finishing, a flat file about five inches in length is used, one side of which is at least as fine as a six cut, and better still if it be a seven or eight cut. The other side is not cut at all, but is perfectly smooth and polished for use as a burnisher.

With the cut side of the file, the pin is smoothed down until it is very nearly as it should be, fitting the tube snugly. It is then burnished with the smooth side, until the pin becomes perfectly smooth, having a polished surface and fitting the tube easily throughout its entire length.

The burnishing is perhaps the most important part of the operation of making a split pin, for the reason that no matter how fine the file which is used in fitting the pin may be, it leaves a surface, which, under the microscope, will seem to be very rough, the serrations or fine ridges and grooves presenting the appearance of a very fine thread of a screw. If the pin should be used without any further finishing, these serrations, being so very fine, would wear smooth very quickly, thus reducing the size of the pin to that extent and rendering it loose in the tube and making what might be termed an ill-fitting or loose-fitting pin.

Too much importance cannot be placed on the proper fitting of the pin into the tube. The pin should fit the tube easily. If it fits too tightly, it would be difficult when the bridge is waxed in position for soldering to remove the outer from the inner parts without springing or distorting it, and it would also require too much force to remove the bridge from the mouth. If the pin goes into the tube touching the sides for its entire length it may fit easily, so that it will slide out and in without any great effort to move it.

If the tube is very long, necessitating a split pin of great length, the end of the pin can remain closed and at any future time, if it should be necessary to spread it in order to give the pin greater retentive power, it can be opened a little in the middle, thus making a long, narrow, elliptic spring (Fig. 526). If the pin is short, then it is filed open at the end and the end carefully rounded, polished and burnished.

In filing it open at the end, the file should follow the direction of the split until it is open (Fig. 527), and not across the split. The reason for this is that in filing across the split, as soon as the solid

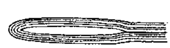


FIG. 526

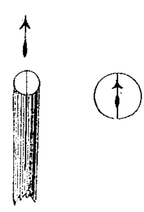


FIG. 527

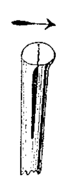


FIG. 528

end is filed through, even if a very fine file is being used, the farther half of the pin is forced away and a feather edge is turned over on the far side of the inner half and some particles of the filings may be forced between the halves, thus spreading the pin and making it difficult or preventing it from entering the tube (Fig. 528). This would necessitate still further filing and consequent weakening of the pin.

THE WEINSTEIN DEVICES FOR MAKING SPLIT PINS.

Mr. L. J. Weinstein, of New York, has invented a swaging device to assist in the making of split pins. It is of the utmost value, and by its use one is enabled to make a plit pin more quickly and accurately than is possible by simply forging and filing (Fig. 529).

FIG. 529

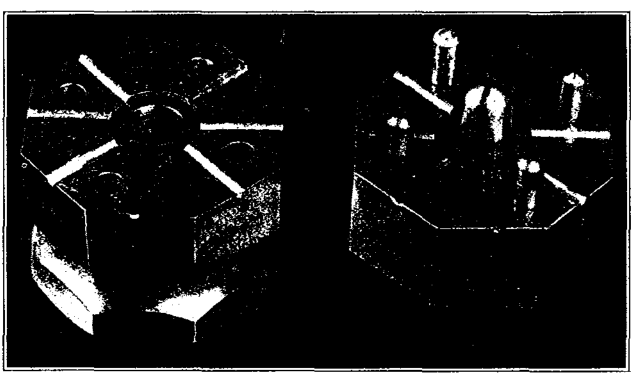


FIG. 530

The device consists of a double anvil, octagonal in shape. The two halves are faced off so that there is perfect contact between the two faces, and these are guided to, and held in their proper positions with dowels. From each of the octagonal faces, a hole is drilled toward the center between the halves, leaving half round grooves of equal size in each of the working surfaces. These have been reamed and polished and the sizes of the holes are a little more than one-thousandth of an inch larger than the mandrel corresponding in number to the number on the swager (Fig. 530).

The half round wire used in making the split pins is a little more than one one-thousandth of an inch larger than the hole in the swager in which it is to be finished. A draw plate comes with the outfit, the numbers corresponding with the numbers on the swager and the mandrels (Fig. 531).

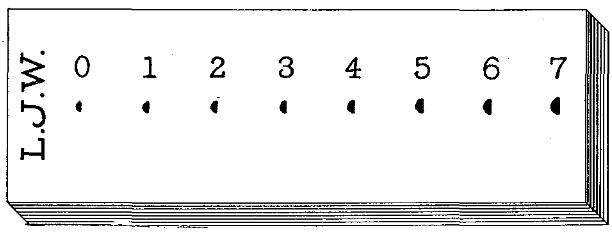


Fig. 531

Although the wire ("elastic" gold, Weinstein's formula) may be purchased in suitable sizes, thus avoiding the necessity of drawing, it is well to have the draw plate in case of emergency, as it is essential that the size of the wire used should correspond with the pin it is desired to make.

Fig. 532 shows a small drawing machine invented by Dr. C. F. C. Mehlig, of New York, for drawing wire and tubes. It is a wonderful little machine, and is geared so that a heavy wire can be drawn down with almost no effort.

Making the Split Pin.—The wire, of a number corresponding to the number of the mandrel over which the tube has been made, is bent upon itself, brought in contact as shown in Figs. 517 and 518, and soldered with coin gold. The extending end is then grasped in the pin-vise, the looped end placed in the groove on the top of the anvil (Fig. 533), and the two halves brought in contact with a small copper or fiber faced hammer.

In order to bring the two halves of the pin into perfect contact, prior to the final forging, the pin is first placed into the swager, with the split lying horizontally, and struck once with a good sharp blow. If the pin is to be, for example, a number 3, the closing is to be done in the number 3 hole. After the pin is closed, it is then annealed and first swaged in number 5 hole and hammered with a heavy round-faced rawhide, or fiber-faced mallet, rotating the pin constantly until the two faces of the anvil are in contact. (See

FIG. 532

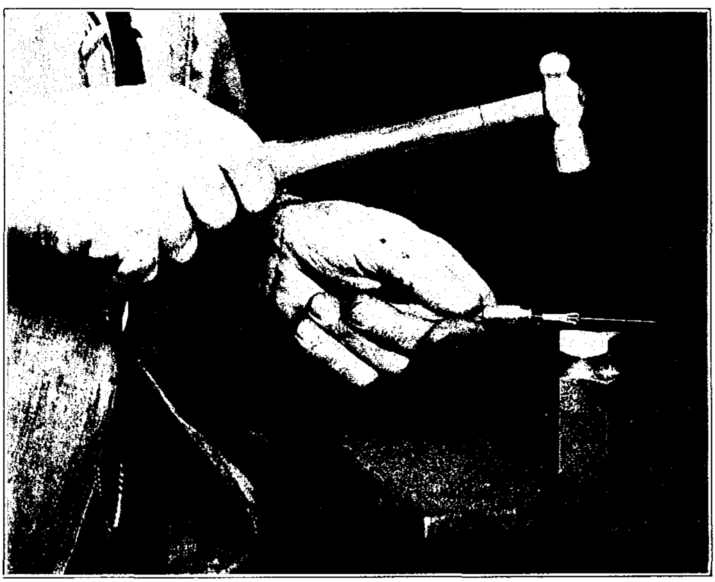


FIG. 533

Fig. 534.) It is then annealed and hammered in the number 4 hole, then in the number 3 hole, and when the two faces of the swager are in contact, the pin is quite round, the sides are parallel, and it is slightly larger than the tube, just enough to allow for finishing. It is

FIG. 534

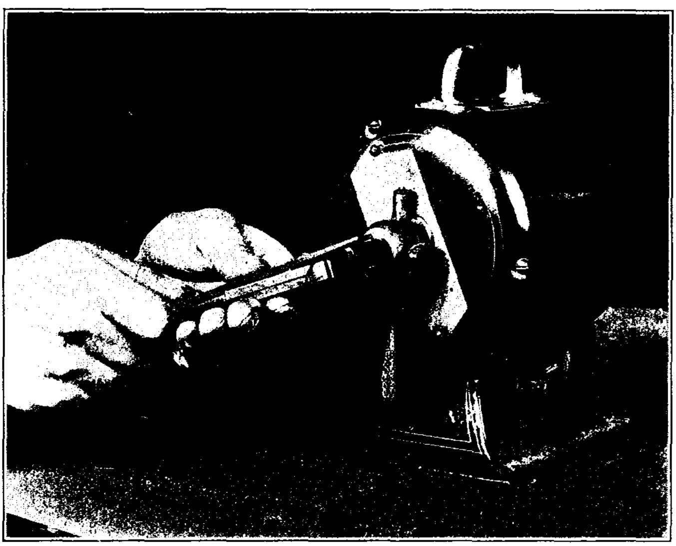


FIG. 535

then annealed again and finished with a fine file and a burnisher as has been described or it can be burnished on the lathe.

Finishing the Split Pin on the Lathe.—It is necessary to have a chuck of suitable size and kind to grasp the pin firmly. It is then brought down with a very fine file until it will just enter the tube tightly. The filing can be done more easily and perfectly if the under surface is supported by a very fine file on an instrument with a smooth flat surface, as shown in Fig. 535. The burnishing is done with another device of Mr. Weinstein's, which consists of two hinged, hardened, and polished plates, one of which is grooved to receive the pin (Fig. 536). The two plates are brought together,

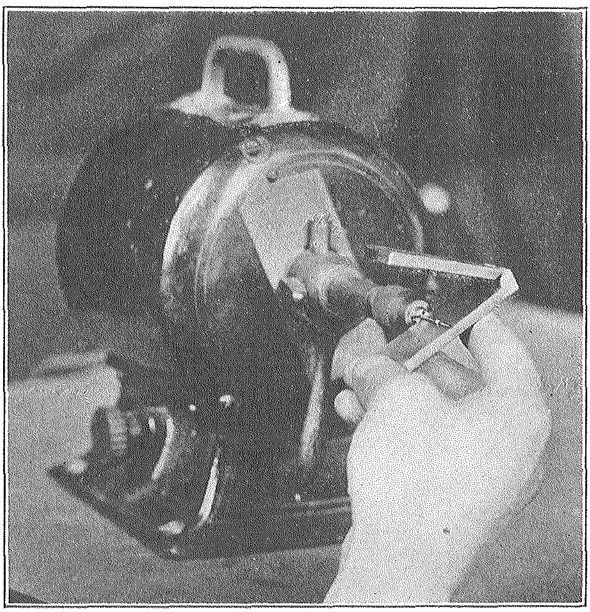


Fig. 536

the lathe run at full speed, the burnisher being moved outward and inward on the pin (Fig. 537), this giving it a smooth and highly polished surface.

While still in the lathe chuck, it is polished with fine crocus cloth and reburnished. The pin is then opened at the end, and rounded in the manner already described (Fig. 527) or left closed in a long pin. (See Fig. 526.)

The split-pin swager illustrated was originally made with eight grooves between the two halves to provide for the six pins according to the stub steel mandrel sizes, .058 inch to .075 inch, and two extra grooves for the preliminary swaging (of No. 6 pin). It has been found advisable, however, to reduce the number of the

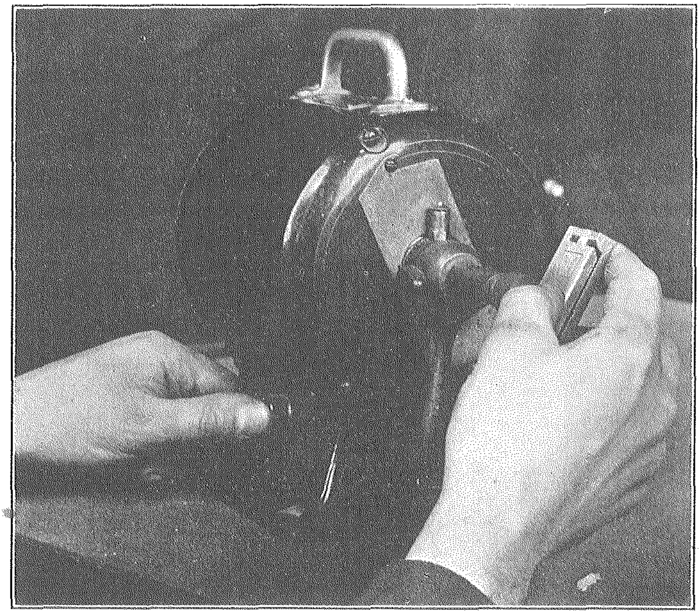


Fig. 537

grooves, mandrels, etc., for both the swaging device and paralleling device and the various accessories and the completed device, both for paralleling and swaging now furnished are standardized for four sizes, as follows: No. 1 equals 0.060 inch; No. 2, 0.064 inch; No. 3, 0.068 inch, and No. 4, 0.072 inch.

The split-pin swager, burnishing clamp, fiber-faced mallet, draw plates for both wire and tubing and accessories, such as files, etc., are manufactured by the Dental Utilities Co., of New York.

ANOTHER METHOD OF USING THE TUBE AND SPLIT PIN.

There are cases where the ordinary way of using the tube in the root with the split pin attached to the bridge is not practical and it is necessary to devise some other method. In some cases a complete reversal of this type of attachment is indicated, using the split pin on the inner cap attached to the root, while the tube is imbedded in the bridge. There are times where the roots stand on such divergent angles that it is not possible to insert tubes to a sufficient depth to give retention and have them parallel, and it is in such cases that the reversal of order is more frequently indicated. Take for example two cuspid teeth in the lower jaw, standing as represented in Fig. 538.

In a case of this description, the roots are prepared in the same manner as when they stand in a normal position, with the exception

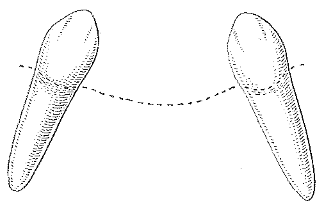


Fig. 538

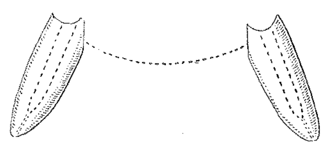


Fig. 539

that the mesial or approximal sides are cut well away, as in Fig. 539, in order that the bands may be adjusted with their sides nearly parallel to each other. The labial and lingual sides are trimmed, but it will not be necessary to trim the distal sides, as the inclination of the roots is such that the band will hug tightly at these points.

The bands are then fitted, the roots cut down to their proper level, and the canals enlarged to receive a strong post. Posts are then placed in the canals, extending well above the bands and a plaster impression taken with bands and posts in position as in Fig. 540.

A model is then made and the work from here on is done entirely on this. The bands cut flush with the top of the stump and the floor of No. 28-gauge coin gold is sweated to them.

The pins are made from half round platinized gold wire, the same as the ordinary split pin, and being soldered for about three-eighths to one-half an inch, leaving them open for about one-quarter of an inch from the upper end. The pins are then fitted to the tubes which have previously been made and should be of about a No. 3 or No. 4.

Openings are then made through the floors of the caps to fit the pins tightly and the floors polished. The upper ends of the pins are then grasped in the pin-vise so that they are clutched just below the point where they are soldered and are bent so that the bend will come just beneath the floor and when they pass through the floor they will stand parallel with each other (Fig. 541).

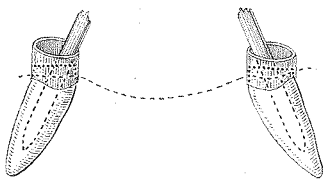


FIG. 540

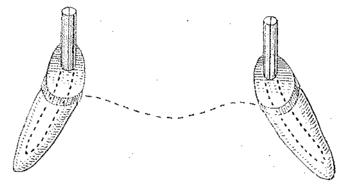


FIG. 541

A little wax is placed around the pins where they pass through the floors, the wax being very hot and afterward every particle of wax should be scraped from around the pin and off the floor so that no solder may draw through at this point. A little impression is then taken, in investment material, of each of the caps with the pins in place. The caps and pins will probably come away with the impression. If not, they are removed from the stumps and carefully placed in the impression. The investment impressions are dried out, the pins fluxed on the inside of the caps where they pass through the floors and they are soldered to the floors from the inside with 20-carat solder, as shown in Fig. 544.

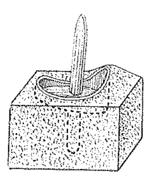


FIG. 542

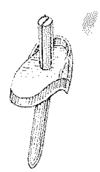


FIG. 543

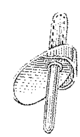


FIG. 544

They are thus soldered from the inside, so that no solder may flow on the outside of the floors of the caps or around the pins and thus interfere with the fit of the tubes and outer caps.

Making the Outer Cap.—In making an outer cap for this style of abutment, a floor of No. 28-gauge coin gold is used and the hole is made so as to fit the pin easily, but not loosely. It is then cut flush with the sides of the inner cap and the half-band fitted to it and soldered as in the making of a cap of the regular type, after which it is replaced on the inner cap (Fig. 543).

The tube, which should be the exact length of the pin and closed at the upper end, is next placed over the pin and is made so that it will set down closely to the floor all around and is waxed to it with a hard tough wax. It is then removed, a little investing material carried into the tube and a small iron wire inserted, letting it extend about one-quarter of an inch below the floor, as in Fig. 544. This will hold the tube in place so that it will be impossible for it to shift its position and it is imbedded in the investment (Fig. 545). The tube is soldered to the floor with 21- or 22-carat solder.

After cleansing and drying the facing is ground to the floor of this cap (Fig. 546) and when the bridge is invested for soldering, a small wire is inserted into the tube and imbedded in the investment the same as when attaching it to the floor, to prevent it from shifting.

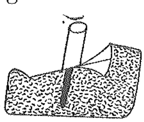


FIG. 545

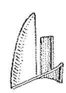


FIG. 546

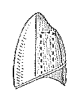


FIG. 547

In soldering this crown, it is necessary that the tube should be completely imbedded in and entirely covered with the solder which should be of 20 carat. It is rarely that the proper lingual contour of a cuspid crown of this type can be obtained as the tube is of such bulk and must have sufficient length to give it retention, so that the crown will necessarily be bulky on the lingual side (Fig. 547), often presenting something the appearance of a lower first bicuspid.

These crowns may at times be used in any of the teeth anterior to the molars and form practically as good an anchorage as a crown of the regular type, but as they are more difficult to make they are not used except where especially indicated.

In cementing these caps, it is not possible to cement them in the way in which the caps of removable bridges are ordinarily cemented, as the inclination of the pins is such that they could not enter the roots. In this type it will be necessary to set the crowns separately, using only as much cement as is required to set them properly and then placing the bridge over them immediately, before the cement has had time to set, thus insuring their being perfectly seated in their proper position. The outer caps should be coated with cocoa-butter so that if a little of the cement should get between the outer and inner caps, they could be readily separated.

CHAPTER XIV.

METHODS OF USING PORCELAIN CROWNS WITH CAST BASES IN REMOVABLE BRIDGE-WORK.

With the advent of the casting process, came the more general use of all porcelain crowns for bridge-work, in place of the facings or veneers which had heretofore been used to partially hide the mass of gold of which the bridge proper was constructed, thus producing much more artistic effects than was possible by the old methods.

The casting process, however, has its limitations, and is very far from being a "cure-all" for everything. There are far fewer cases where this process is really indicated than many seem to think. Those who expected to use it to the exclusion of every other method have doubtless found themselves badly mistaken.

In long bridges, where great strength and stability are essential, the casting process is not indicated, as the cast bridge is far inferior in strength to a soldered bridge, and the shrinkage of a large piece in casting is such as to render it unsuitable where great accuracy is required. In some instances, it is much more suitable for fixed bridges than removable, and then again, the reverse may be true. Good judgment must be used in its application, and it must be used only where indicated to avoid disappointment.

In a large number of instances, the casting process may be used for certain parts of the work, but it is very rarely that it should be used throughout the whole operation.

The depth of the bite is a very essential factor in using porcelain crowns in bridge-work. This must be great enough to allow sufficient room for a good substantial base in order to give strength and stability to the bridge. A very close bite is altogether unsuitable for the use of crowns, and where we have this condition, we must resort to the older methods in order to produce results which will be satisfactory and durable.

Porcelain crowns are especially applicable in the anterior part of the mouth, as all porcelain crowns present a much more life-like and natural appearance than does a facing which is backed with metal, although there are many cases where it is impossible to get shades which will answer the purpose. The incisal edges of the teeth, especially, are frequently lacking in that clear translucency which is to be noticed in most of the natural teeth, and it is often necessary to resort to the backed facings, even when making restorations in the posterior part of the mouth, but the bicuspids and molars are much more easily matched than are the incisors.

In making a bridge of this character, the crowns of any of the different manufacturers which come nearest, in mould, shade, and texture, to the requirements of the case may be used. There must be a sufficient depth of bite to allow of every crown having a base deep enough to give strength and stability to the bridge.

It would be well to first consider a bridge for the anterior part of the mouth, restoring the six anterior teeth, using the cuspid roots as abutments. The caps, together with the tubes and split pins, are made as has been previously described, and an impression for the saddle taken, the model and dies prepared, and the saddle swaged of No. 32-gauge soft platinum. Unless the bite is extremely long, and there has been considerable resorption, the saddle should extend only to about half or two-thirds of the way over the ridge labially, as at least one-third of the base of the crowns, labially, should be made to fit closely on the ridge. The saddle is reinforced with coin gold, adjusted to the ridge and the relation of the saddle to the caps taken with the saddle under pressure. The impression and bite being taken together.

The model is then prepared and the crowns are ground in position. The cuspid crowns should first be fitted and ground so as to touch the labial third of the floor of the outer caps, clearing enough lingually to afford a strong base and the lingual and mesial sides are beveled, as in the case of single crowns in Fig. 548.

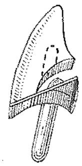


FIG. 548

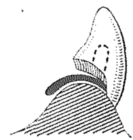


FIG. 549

The incisor crowns are then ground in, the model having been scraped somewhat to allow of their setting closely against the gum when the bridge is completed. They should fit the plaster model on the labial side, but should be ground to clear the saddle well lingually, so as to get a sufficient depth of metal for strength, as in Fig. 549.

The lingual and mesial and distal sides of the base of the crowns are then beveled the same as the cuspid crowns have been, and after the crowns have all been arranged in a satisfactory manner, they are waxed in place.

Making the Bases.—In a large number of bridges of this character, which are made for the anterior part of the mouth, it will be found that the lingual contour of the crowns is not sufficient to give the necessary strength after they have been ground in position, and where such is the case, it is necessary to first build them up on the

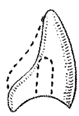


Fig. 550

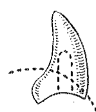


Fig. 551

lingual sides before grinding (Fig. 550). This is especially true of the crowns made by some manufacturers. If the base of the crowns are ground away lingually as much as is necessary, it will leave practically no hold for the post, and very little bulk of porcelain back of it to give the necessary strength to the crown, as will be seen in the illustration (Fig. 551). It will also decrease the labial lingual depth of the base of the crown by about one-third. This will apply both to the cuspids and to the incisors, and it is very rarely that the writer uses these crowns without first building out the contour considerably in porcelain on the lingual side before grinding. Then, too, the shapes of the cuspid crowns are scarcely ever normal, the lingual surface being decidedly concave and more the shape of an incisor, while it should be thick and heavy, as shown in Fig. 552, indeed often being slightly convex rather than concave.

The enamel on the lingual side of the crown should be first ground away with a fine carborundum or an emery disk, so as to afford a better attachment for the porcelain which is to be baked on. The porcelain is then built in heavily, as in Fig. 549, enough being added so that when the base of the crown is ground away, as in Figs. 548 and 549, the labial and lingual diameter is great enough to cover the entire cuspid cap, and in the incisors so that after grinding, the lingual side will be extended so that the pin will come up near the center of the crown or, better still, a little labially, the bulk of the porcelain being on the lingual side.

After the crowns are properly ground, it will generally be found that the post-holes are too shallow to give support and they should be deepened enough to allow of the use of a post of sufficient length to give ample support. This may be done by using a copper wire in the engine and deepening the hole in the crown with carborundum. Carborundum and oil may be used, or what is still better powdered carborundum and glycerine, the glycerine forming a good vehicle for carrying the powder, and at the same time being much more easily washed away, as the glycerine, mixing freely with water, will permit of the cavity being washed out quickly with clear water, while in using the oil for carrying the carborundum, which will cut no better than glycerine mixture, it is necessary to wash thoroughly with soap and water.

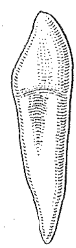


Fig. 552

Making Copper Drills.—Copper drills are easily made. A piece of wire of the same size and of about the same length as the shank of the engine burs is secured and one end ground or turned down, for about one-half an inch, to the size which the holes in the crown are intended to be. They are then placed in the hand-piece and used in the same manner as an engine drill.

The point of the copper drill is dipped into the carborundum and glycerine and entered into the hole in the crown and the engine run rapidly, the point of the drill being moved up and down so as to keep the carborundum and glycerine constantly in the bottom of the cavity. This should be continued until the cavity is of a sufficient depth. The end of the drill should be perfectly flat, or still better slightly countersunk, so that it is enabled to hold the grinding powder better. It may be countersunk by running it rapidly and holding the end against the end of a small drill or bur. A number of these drills may be made and kept on hand and recountersunk from time to time as the ends become rounded, for when the drills are so worn they do not work well, the carborundum and glycerine working on the side rather than at the point of the drill.

The crowns being finally ground in position, a wall of plaster is built up on the labial side, extending to within a thirty-second or a sixteenth of an inch of the incisal edge, as in Fig. 553. The next step is building up of the bases in wax, preparatory to casting.

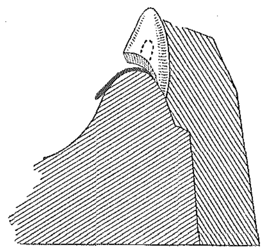


Fig. 553

The greatest difficulty with which the operator has to contend in making these bases is due to the contraction of the cast metal on cooling. The result is that the crowns do not fit as they should, and there is more or less cutting, trimming and fitting to do, before they will go in place, and not infrequently it is even necessary to do the work over again, and perhaps even then the desired result will not be attained.

The method has been tried of first burnishing or swaging pure gold over the bases of the crowns and then waxing up and casting on to the pure gold. This has perhaps improved the matter somewhat, but still it is very rarely that it has been possible to secure anything like a perfectly-fitting base, especially if the crowns are of any considerable size, for with the larger castings there is a proportionately greater amount of shrinkage.

One method of overcoming this difficulty is that of building out, or enlarging, the base of the crown before waxing, in order to make up for the shrinkage of gold. After some experimenting, a plan was devised, which, while not entirely overcoming the difficulty in every instance, probably due to faulty technic, has, in the majority of cases reduced the trouble to a minimum. The method does not do away with the shrinkage of the gold, for that is an inherent property which nothing can overcome, but by it the operator may counteract or make allowance for this contraction of the metal on cooling.

The method of procedure is as follows: Tin foil, of varying thicknesses, according to the size of the crown which is to be used, is burnished or swaged over the crown base, in reality first making a base of this metal, letting it extend just a little above the beveled edge of the crown, as in Figs. 554 and 564.

The tin foil base is then lubricated with cocoa-butter, and the wax base is built over the tin foil, the lubricated surface allowing of its easy removal. The size of the base of the crown has, of course, been increased the amount of the thickness of the tin. Allowance for the shrinkage has thus been made so that when the crown is placed in the casting it fits very closely, and if the technic has been carefully carried out there will be little or no trimming to be done after casting. The thickness of the tin foil is varied according to the size of the crown, the largest of course requiring the heaviest foil. Three sizes are used, the first being about .004, the second .006, and the third .008 of an inch in thickness. The burnishing of the foil over the bases is very quickly and easily done. The lighter foil can be pressed nearly to place with a piece of soft rubber and the wrinkles at the edges smoothed out with the thumb nail or a piece of orangewood. With the heavier foils a piece of orangewood and a small burnisher are all that are required to secure the close adaption which is necessary to insure a perfect-fitting base.

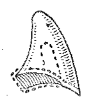


FIG. 554

In making the bases for a series of crowns for a bridge, it is not advisable to cast them together in one piece. The obvious reason for this is that if the bridge be of any considerable length, the shrinkage would be proportionately greater in that direction, so that it would be necessary to grind the crowns on their approximal surfaces, before they would go into position on their bases. This would result in shortening the body of the bridge, and leaving a space at the extremities between the crowns and the adjoining teeth or the abutments. The best method is to cast the bases separately, and in no instance should more than two bases be cast together. The casting of each base separately, and afterward uniting them does away with the shrinkage which would otherwise take place.

The casting of the bases for abutment crowns may be done directly on the caps, or they may be cast separately and afterward soldered to the caps, and the operator may choose whichever manner he wishes, although the latter method is perhaps preferable at times in removable work, as there is less danger of disturbing the accuracy of adjustment between the outer and the inner caps.

The same method of procedure obtains where a saddle is used as an auxiliary support to the abutments and the crowns mounted on this saddle. If the saddle is small, as it would be in the case of a restoration of a single tooth, and if there is not great depth between the occluding teeth and the saddle, the crowns are ground so as to leave sufficient space for the base (Fig. 555) and then beveled as in shown Figs. 555 and 556. The crowns are tinned and lubricated in

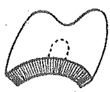


Fig. 555

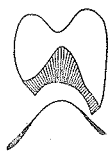


Fig. 556

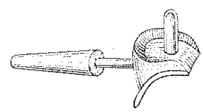


Fig. 557

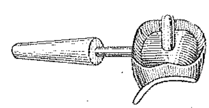


Fig. 558

the manner described, but the saddle is left perfectly dry and clean. The wax is then flowed between the bases and the saddle and carefully carved to represent the gum. The sprue wire is attached to the lingual side, and the crowns are removed from their bases as in Figs. 557 and 558. A little space on the sides of the saddle is left exposed and free from wax so that it may be caught and held firmly in the investment for casting. After investing, it is cast in the usual manner with coin gold.

After the casting has been made and cleansed, it is waxed to the abutment cap or caps, as the case may be, and invested preparatory to soldering the base and saddle to the caps. The inside of the bases are well covered with whiting so that no solder may flow in and destroy the fit of the crowns. The piece is then heated up and soldered with 20- or 21-carat solder. Where the bases are cast separately and afterward soldered to the saddle or the caps, both the saddle or caps and the tinned base of the crowns are first lubricated. A little of the inlay wax is then pressed into the hole in the base of the crown to serve as a post and trimmed off so that it is only a little more than flush with the base.

The crown is held in position on the model by the wall which is made for this purpose, and the inlay wax is flowed over the caps or the saddle between it and the crown. The wax should be used quite hot so that it will attach itself to the wax post in the base. The space between the cap and base is well filled in, leaving it perhaps a little more than flush with the sides of the crown, covering the beveled edges well. It is then carved and the sprue wire attached to the lingual side. The crown is then carefully lifted away from the wax base and the wax base removed from the cap or saddle.

Before waxing, it is well to make a couple of little pits or slight grooves at different parts on the cap or saddle so that when the base is cast, it will be positively seated in its proper place (Fig. 559). On the cap a slight countersink with a bur or drill may be made in the top of the post and another at some point near to it and on the saddle at any place where the platinum has been covered with coin gold. After the bases have been cast and cleansed, they are adjusted in position on the saddle or caps, and invested, being held in place by a little wire clamp. The top of the post is slightly countersunk and the end of the wire clamp is pointed.

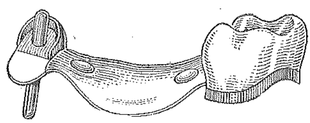


Fig. 559

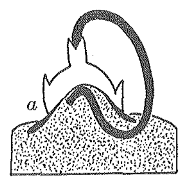


Fig. 560

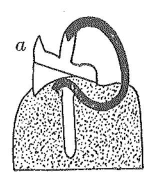


Fig. 561

In the case of a saddle, the wire clamp extends from the top of the post to the under part of the saddle directly beneath it, just clearing it on the buccal side, as shown in Fig. 560. Where the base is to be soldered to the half cap, the wire extends from the top of the post to the under part of the floor, and as nearly on a line with the crown post as possible, as shown in Fig. 561.

The investment should be very light and just fill the under side of the cap or saddle, having only enough to hold the parts in position, leaving the whole of the upper parts exposed. This facilitates the thorough heating-up of the piece and the solder is easily drawn through from the lingual side, uniting the bases to the saddle and to each other. The crown side of the bases should be well coated with whiting or some antiflux, so that there is no danger of the solder flowing over this surface.

The solder is used in strips, and is fed from points *a* in Figs. 560 and 561. The invested pieces are heated up very highly and the solder drawn entirely through from these points. It may be flushed over the lingual sides as much as is required. Twenty or 21-carat solder is used for this purpose, but the 21-carat is to be preferred, as it is not likely to be disturbed when a lower carat is used in a subsequent soldering operation.

Deep Saddle.—Where there has been a considerable amount of resorption and there is a great depth between the occluding teeth and the ridge, it would make these bridges unnecessarily and undesirably heavy to build solid bases extending from the crowns to the saddle. This will apply where there is to be an abutment at each end of the bridge, and also in extension saddles which are anchored only at one end, as in the lower jaw where the molars are missing. The bases may be made in the form of a ring, covering the beveled edge and extending only far enough underneath to form a positive seat for the crown, as in Fig. 562.

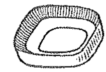


Fig. 562

After the crowns have been ground in place, they are fastened in position with sticky wax and plaster is flowed over the occlusal surfaces extending over the buccal and lingual sides for a short distance and engaging the plaster teeth or model at either end, as in

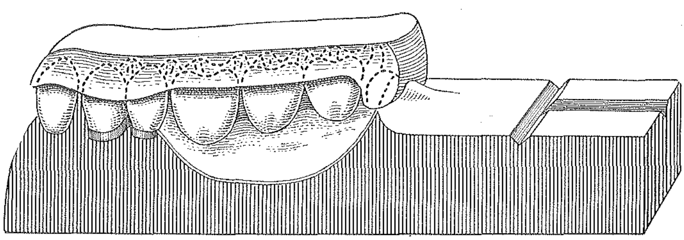


Fig. 563

Fig. 563. The lower edges of the crowns are beveled, as Figs. 555 and 556, so that the bases may extend over the gingival edges, gripping them tightly, thereby affording a firm seat and minimizing the possibility of a fracture. They should be beveled so that the line of the bevel on the buccal and lingual sides will follow the natural curve of the occlusal surfaces so as to present a symmetrical appearance which would not be the case if they were beveled carelessly, one being shorter than the other. This can be done very easily, as the occlusal ends of the crowns resting in the plaster, expose the entire body of the crown, the operator can plainly see what he is doing and nothing is left to guess work.

The bases of the crowns are then tinned in the manner already described and should be made so they will barely touch mesially and distally and are caught with very little sticky wax on the buccal and lingual sides (Fig. 564, *a* and *b*). If there is a porcelain crown on the mesial abutment, the base of this should be made and attached to the cap. The other bases are then built on in wax, being waxed against the base on the anterior abutment, but between each of the others, a thin piece of oiled paper should first be placed, completing the base over the first crown, then smoothing the distal side, placing in the waxed paper and then making the wax base for the second crown. When this has been completed, the distal side is smoothed off and another piece of the waxed paper is put in and

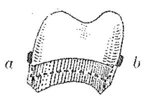


FIG. 564

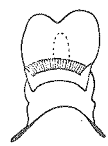


FIG. 565

the third base completed. These bases are all beveled inward, as shown in the illustration, Fig. 565, the reason of which will be seen later.

The sprue wire is now attached to either the buccal or lingual sides, as in Fig. 566, and each of the bases are cast separately in coin gold. After casting, they are cleaned in hydrofluoric acid. They are now fitted to the crowns and it is rarely that it will be found necessary to do any trimming in order that the crowns may be properly seated, except to cut out any little bits of the metal which may be there owing to small bubbles in the investment.

The buccal and lingual sides are then smoothed by beveling downward and inward, as already stated. The occlusal surfaces of the crowns are pressed into the plaster impression and are tacked lightly on the buccal and lingual sides with sticky wax. The cast ring bases are then placed on the crowns and are pressed tightly in place and waxed together with sticky wax, after which they are removed, invested and united with 21-carat solder. These united bases are then placed back on the crowns and tacked lightly with wax, the whole being suspended from the plaster impression extending over the occlusal surfaces, as in Fig. 563. They are then placed on the model, as in Fig. 563, and the bases are attached firmly to the abutment caps at either end or where there is an extension saddle mesially to the base of the crown serving as an abutment and distally to the saddle on which the last ring should rest, as in Fig. 567.

The crowns are then removed and the saddle is invested for soldering. The under side of the saddle and abutment cap, or caps, are filled with the investment and the remaining investment is placed on the slab and smoothed off, leaving it about one-half an

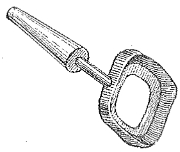


Fig. 566

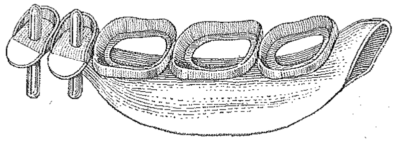


Fig. 567

inch in depth. The saddle is then settled lightly in place to the depth of about one-eighth of an inch and some of the investment brought over the saddle at the middle part and under and over the middle ring, but not coming near the mesial or distal ends which are to be united to the abutments or the saddle, as shown in Fig. 568, *a* and *b*. The inside of the exposed rings and the

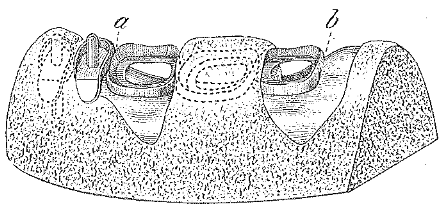


Fig. 568

inside of the base on the abutment caps are well coated with anti-flux and the investment is heated up and soldered with 21-carat solder, enough of the solder being used to unite the rings firmly.

The saddle is then cleansed and thoroughly dried and all the crowns placed in their proper positions preparatory to the final step in the making of the bridge.

The space between the saddle and the ring bases of the crowns is now filled with pink paraffin and wax both on the buccal and lingual sides. The wax is then carefully carved so as to restore the natural contour of the gum. About one-eighth of an inch of the edge of the saddle is left exposed and the wax carried up to about midway on the labial and lingual sides of the ring bases, as shown in Fig. 565. It is then carefully smoothed and polished.

Impressions are now taken of the carved surfaces, and if fusible metal dies and counters are being used, the impression is made deep enough to serve as a model, but if lead and zinc are to be used, the model is made by pouring into this impression. The face of the model should extend from well up on the sides of the crowns to at least one-sixteenth of an inch below the lower edge of the saddle. (See Fig. 601.)

The dies and counter dies are made and plates of No. 28 or No. 30-gauge coin gold struck-up and carefully fitted and adjusted to the saddle. The dies should be perfectly smooth and, if necessary, the surfaces should be polished before swaging-up the plates. One of the plates is carefully adjusted in position and held in place with a clamp over the edge of the saddle, and the piece placed in the investment, open side down, leaving the side on which the plate is to be soldered exposed, as in Fig. 569. The investment is dried out and the inside of the ring bases, the underside of the saddle and the outside of the plate, to within about one-thirty-second of an inch of its edge all around, coated heavily with whiting or other antiflux.

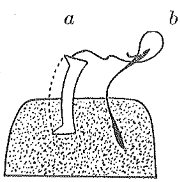


Fig. 569

It is then well fluxed between the plate and the saddle and also between it and the rings, and the parts thoroughly united with solder. The solder is best used in strips and should be 20-carat. The plate is first united to the ring bases, flushing it from the upper edge of the plate to the top edge of the ring, as in point *a*, Fig. 569.

After this has been soldered, the plate is united to the lower edge of the saddle at point *b*, Fig. 569. The solder is used in a strip and is fed in along the edge of the saddle between the two surfaces until it has thoroughly drawn through at all points throughout the length of the saddle, uniting the saddle and plate firmly. These extension saddles should not be chilled quickly, as should this be done there is a liability of their springing and becoming distorted. They should be allowed to cool slowly and are then removed from the investment and cleansed.

The plate for the opposite side is next clamped in position and invested in the same way as for the plate already united. It is then soldered in exactly the same manner as the first, uniting the plate to the ring and afterward to the saddle and after cleansing and drying is ready for finishing. The only points which need to be touched with the stone are at points *a a*, Fig. 570, where the plate is united to the ring and it should be necessary only to smooth this over but a very little unless an excess of solder has been used. The edge of the plate and saddle at points *b b*, Fig. 570, should be smoothed and rounded. It will not be necessary to touch the face of the plate with the wheels if the dies have been smooth, as the whiting or antiflux which has been placed over the face should prevent any solder from flowing down over it. The bridge is polished as already described, following the carborundum wheels with fine emery and cuttle-fish disks and afterward touching lightly with pumice and then finishing with the rouge. The bridge is now ready for the attachment of the crowns.

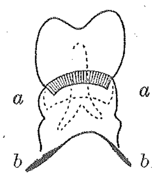


FIG. 570

The object in making a saddle bridge in this manner, instead of casting what might be called the entire shell, and then uniting it to the saddle, is that the rolled coin gold plates present a perfectly dense homogeneous mass, the surface of which can be easily polished, and which takes and retains a very high finish, while the surface of a casting is always more or less porous and will not take as high a polish. It is also much lighter and stronger than it could possibly be made by casting.

The crowns are fitted with posts which extend through the opening in the bases into the body of the saddle. These posts may be made from discarded platinized gold split pins, the lower end of which is spread a little, as shown in Fig. 570. These posts are first cemented into the crowns. The hollow body of the saddle is next filled with cement, and the crowns put in place and held there under pressure until the cement has hardened (Fig. 570), after which the excess cement is cleaned away and the bridge is ready for the mouth.

A saddle bridge made in this way presents a most beautiful appearance and does away entirely with the showing of the gold. At the same time a maximum amount of strength with a minimum amount of weight has been obtained.

EXTENSION SADDLE BRIDGES.

The most difficult piece of work which the crown and bridge specialist may be called upon to do, and which requires the greatest skill and accuracy in its accomplishment, is the making of a satisfactory extension saddle bridge for the lower jaw, restoring the lost molars or molars and bicuspids. A bridge of this character, if it is properly made, will prove as satisfactory as any piece of bridge-work which can be placed in the mouth. On the contrary, if it is not made, fitted and adjusted as it should be, it will prove most unsatisfactory and will ruin the abutment teeth more quickly than any other form of denture. Extension saddles should not be placed in the mouth excepting where the teeth have been out for a long time and the ridge has become well resorbed, and the tissues are well hardened. It is rarely that they should be used unless the teeth have been out for a year or more.

In almost every case, there should be at least two anchorages, either two bicuspids, or a cuspid and bicuspid, although there are cases where the alveolar ridge is very pronounced and is very hard, especially if a partial plate has been worn for a number of years, where a single anchorage might be sufficient.

When a mouth is in the proper condition for a bridge of this character, the top of the ridge is very hard, in fact there is but little thickness of soft tissue over the bone on the top of the ridge, and this hard ridge will not be much more than one-sixteenth of an inch broad, the tissues thickening gradually on either side as they leave it, as in Fig. 571.

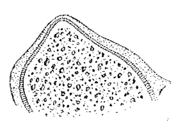


FIG. 571

Next to the proper preparation of the abutment teeth or roots, and accuracy in making and fitting the abutment crowns, the success of a bridge of this kind depends upon the perfect adaptation of the saddle to the ridge.

It is usually best to first make the abutment caps or crowns. If they are to be telescope crowns, then these crowns should be made and articulated, and also connected together, making sure that the abutments are parallel. If they are to be porcelain, or porcelain faced crowns, the entire inner caps are made and paralleled, and the impression taken of these. A model is prepared and the outer half caps with the split pins are made and united together. These, or telescope crowns, if they are to serve as the abutments, should be in position on the roots when the impression for the saddle is taken.

Taking the Impression and Making the Dies and Counter Dies.—The next step is to secure an accurate impression. The writer has obtained excellent results by the following method:

An impression of the ridge is first taken in modeling compound, using a sheet of the compound about one-quarter of an inch thick and not softened too much. This is passed well back over the abutment teeth and ridge and pressed down at the back and on each side with the fingers so as to secure as good an adaptation as is possible. It is then removed from the mouth and chilled. This modeling compound impression is used as a tray for taking the plaster impression. The plaster is mixed fairly stiff so that it will press hard on the soft tissues. This composition tray is filled with plaster in the usual manner, placed in position, pressed down firmly, and so held until the plaster has well hardened.

A good impression having been obtained, the model is then made from it. It should be of good depth, at least one inch at the shallowest part, so that there will be no chance of the die springing or breaking when swagging the saddle (Fig. 572).

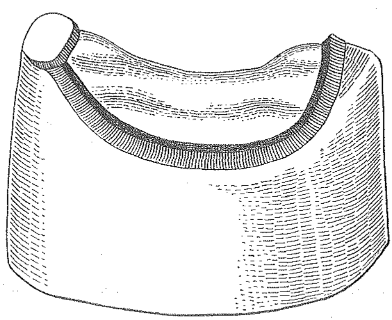


FIG. 572

The model having been prepard, the outline for the saddle should be marked upon it. The saddle should be broad, and should be carried well over the ridge both buccally and lingually, so as to have as wide a bearing on the ridge as it is possible to get for the wider the bearing which the saddle has, the greater will be its usefulness to the wearer.

The edges of the saddle should be turned up somewhat, so that it will present a thick, rounded surface to the soft tissues, and will not cut or injure them. A much broader saddle can be worn with comfort by having the edges well rounded, than would be possible if the edges were left fairly sharp. These edges, when the bridge is completed, should be at least as thick as a No. 16-gauge wire. In order to turn the edge of the saddle, the model is built up with wax as shown in Fig. 572, before die and counter die are made. This die and counter die may be made of zinc and lead or of fusible metal throughout. The writer prefers the latter because of the absence of contraction on cooling, and also on account of the ease with which it is manipulated.

The Saddle.—The saddle is swaged of soft platinum of No. 32 or No. 34 gauge. Platinum is always prefered wherever a saddle is used, as the tissues take more kindly to this metal, and it will keep a clean polished surface even better than will pure gold. Then, too, higher grades of solder may be used than would be possible with pure gold. The saddle should be large enough to allow for the edge being turned up all around (Fig. 573). The little swaging mallet shown in Fig. 574 is very useful in working down the platinum saddles before swaging them between the die and counter. It has a rawhide peen and will not mar the platinum. The saddle is hammered over the die and can be brought down close enough for swaging easily and in a very short time. During

Fig. 573

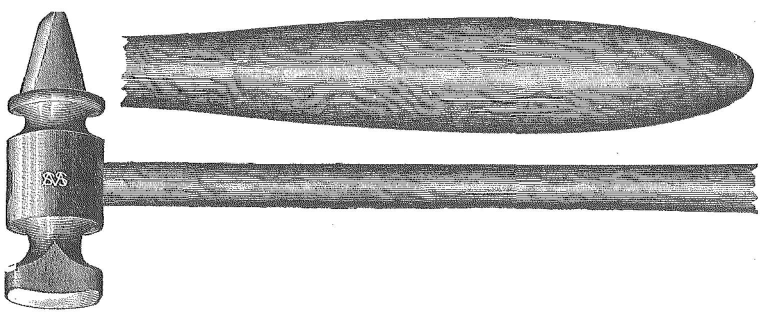


Fig. 574

the swaging it should be frequently annealed, but should always be cleansed in nitric acid after swaging before trimming or heating it up again. After the final swaging, it is again cleansed in acid and fitted to the model.

The platinum being very soft is reinforced to strengthen and stiffen it and this is done with coin gold. The underside of the saddle is painted with an antiflux or whiting as is the top of the ridge back to within about one-eighth of an inch of the distal end and also at the front where it turns up to meet the anchorage or abutment at that point to which it will be attached (Fig. 575). This is to prevent the gold from flowing over these places and the underside

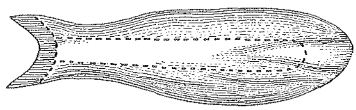


FIG. 575

FIG. 576

of the saddle. The coin gold is then flowed over the exposed parts of the saddle bringing it flush with the turned-up edges of the platinum and distributed as even as possible, as in Fig. 576. Afterward it is made smooth with a carborundum wheel. The flowing of the coin gold over the platinum will have distorted it somewhat, so that it will be necessary to swage it again and after this has been done, it is again cleansed in the acid and is ready for adjustment in the mouth.

The teeth which are to serve as abutments have already been prepared, and the inner caps made and placed in position. The next step is that upon which the success of this form of denture entirely depends—the accurate adjustment of the saddle to the ridge.

The Adjusting of the Saddle to the Ridge.—The front end of the saddle, which is to connect with the abutment, and which was not covered with coin gold is turned back a little so that it will clear

FIG. 577

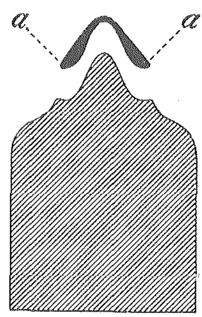


FIG. 578

the abutment when it is in place. It is now placed in the mouth with the forefinger of each hand resting on either side of the saddle, pressing it in place and is rocked from side to side. It will be found that it is resting on the top of the ridge (Fig. 577). It is riding on a little ridge of bone not over one-sixteenth of an inch wide, and is not bearing anywhere else. Should this condition not be remedied resorption would rapidly take place, allowing the piece to sag, and bringing the whole strain on the abutments, with the result that within a comparatively short time the roots would be loosened and lost.

The rocking of the saddle from side to side will give an idea as to the amount of correction which will be needed. The saddle is removed from the mouth and placed on the die. It is then raised off from the die a little and the sides pressed inward to it, the fingers grasping the lower edge of the saddle at points *a* and *a*, Fig. 578. It is then replaced in the mouth and tested again by rocking it. Should the saddle still rock a little, it is again removed and the sides pressed still further together. It is again placed in the mouth and tested, and this is repeated until the saddle sets perfectly solid without any rocking and rests comfortably on the ridge. If it is found that the sides have been brought together too much, so that it presses too hard on either side of the ridge, it is again fitted to the die and the operation repeated until the saddle is perfectly comfortable and immovable under pressure.

Securing the Relation of the Saddle to the Abutments.—The front end of the saddle has been turned back so that it will clear the abutments. After it has been adjusted, it must be ascertained that it still clears the abutment, as should it touch it in the least, it may be pressing against the abutment much more heavily than would be suspected and so be forcing the saddle back out of position.

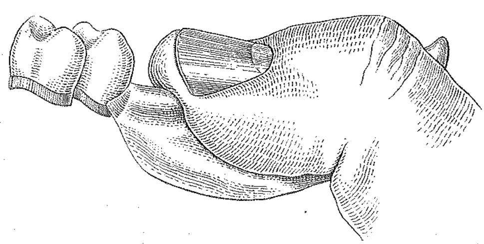


Fig. 579

The next step is to get an impression, securing, accurately the relation of the saddle to the abutment caps. The saddle is pressed firmly into position on the ridge, and held tightly in place with as much pressure as can be brought to bear on it with the thumb or forefinger of the left hand. A saddle on the left side of the mouth, is held down with the thumb, the fingers pressing the underside of the mandible (Fig. 579). Should the saddle be on the right side of the mouth, it is held in place with the forefinger of the left hand with the thumb pressing on the underside of the jaw (Fig. 580).

The plaster is then mixed in the same manner as for taking an ordinary impression, but more of the potassium sulphate, or what-

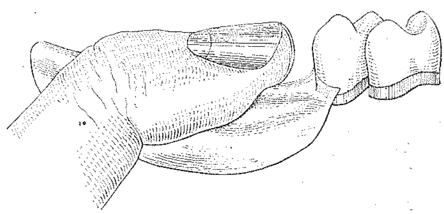


FIG. 580

ever may be used to hasten the setting, should be used, as the plaster for this purpose should set very quickly. The plaster is placed in the mouth with the spatula, covering the abutments, and the end of the thumb or forefinger which is holding the saddle in place and also covering the surface of the saddle wherever it is exposed. The saddle should be held very firmly and steadily until the plaster has thoroughly hardened. The impression is then removed from the mouth together with the saddle and abutment caps. These are replaced in the impression and attached firmly in their respective position with sticky wax. The inside of the inner caps are now given a thin coating of pink paraffin and wax so that they can readily be removed from the model after casting.

A small model not much more than the width of the saddle is then made. It should be of sufficient depth so that there will be no liability of the model being broken, and after it has sufficiently hardened the caps and saddle are removed and it is trimmed and cleansed of the wax with chloroform.

The abutment caps and saddle are then replaced on the model and the anterior part of the saddle, over which no coin gold has been flowed, is pressed over against the caps and trimmed so that it comes just about to the lower edge of the outer cap, should it be a telescope crown, as in Fig. 581, and labially and lingually not quite to the middle of the cap as *a a*, Fig. 582. Should the attachments be caps with tubes and split pins, where facings, or porcelain crowns are used the saddle should be fitted to the lower edge of the half-band and extend part way labially along the floor to *a a*, Fig. 583.

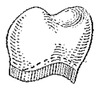


Fig. 581

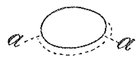


Fig. 582

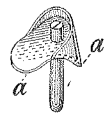


Fig. 583

This end of the saddle is then tacked to the abutments with sticky wax and a piece of iron wire is bent over the occlusal surface or the floor of the caps and carried along the saddle and waxed firmly in position with hard, sticky wax (Figs. 584 and 585). This

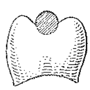


Fig. 584

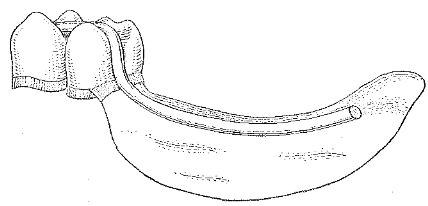


Fig. 585

is to prevent the possibility of distortion when the inner caps are removed and the saddle is being invested. The inner caps are now removed and the saddle with the outer caps attached are invested. The outer caps are filled with investment which should cover the lower edges of the saddle; only a sufficient amount being used to hold the parts in position during the soldering (Fig. 586).

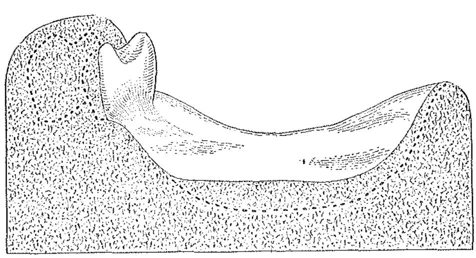


Fig. 586

It is then warmed up, the bulk of the wax removed and the whole heated until the remainder of the wax has burned away, or the wax can be melted out with a stream of boiling water, after which it is cooled slightly and fluxed well between the saddle and the caps. The whole is then heated up and the caps and saddle are united with 21-carat solder, using plenty of the solder and flowing it heavily over the platinum of the saddle which has not been covered with the coin gold. After it has cooled, it is removed from the investment and cleansed in acid, and after it has dried, it is replaced on the model, with the inner caps in place. It will probably be found that when the caps are pressed in position on the model, that the saddle will be raised somewhat at the farther end (Fig. 587). This is due to the solder, of which a considerable

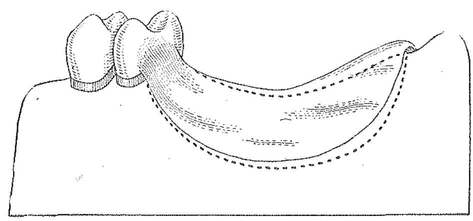


FIG. 587

amount has been used, contracting on cooling and thus drawing up the end.

In order to make up for this contraction, it will be necessary to grasp the abutment caps, and raising the caps and saddle a little off the model, press the distal end of the saddle down, thus springing it back a little at a time until it assumes its proper position on the model. It is now ready for taking the articulation.

Taking the Articulation.—The saddle, with the inner caps in position, is now placed in the mouth and carefully examined to see that the parts are in proper relation. When the caps are pressed in place the saddle should remain firmly seated on the ridge, and the appliance should be perfectly comfortable to the patient. In securing the articulation for this piece, wax or modeling compound may be used, as the appliance will probably come away with the impression and there will be little danger of distortion of the articulation as there might be if it had to be pressed back over a model.

The writer, however, prefers plaster in all cases, as in using plaster there is a certainty that a perfect articulation will have been secured. This is taken in the same manner as in other cases, the plaster covering the saddle well back, as well as the abutment caps, and taking in two or three of the teeth anterior to it. Some plaster is placed over the occluding teeth and the patient is instructed to close the jaws, the other teeth not included in the impression being examined to see that the occlusion is correct.

When the plaster has hardened, it is removed from the mouth, and the saddle, with the inner caps in place, are replaced in the impression. The inside of the inner caps are then given a coating of pink wax and the saddle and outer caps are waxed firmly in the impression, any under-cuts which may appear in the saddle being filled out with pink wax so that the saddle will draw readily after the model has been made. The model is prepared and articulated in the same manner as for an ordinary bridge.

After the model has hardened, it is separated from the impression, the saddle is removed, cleansed of wax and is ready for the adjustment of the crowns, or it may be finished in any way that may seem desirable.

There are many methods of finishing these bridges. The teeth may be attached with vulcanite, crowns of various types may be used or tube teeth, diatoric teeth, or interchangeable teeth—now and again prove very satisfactory.

Vulcanite Attachment.—Where a vulcanite attachment is used, the attachment of the saddle to the abutment caps must be reinforced. If telescope crowns have been used, round or half round platinized gold clasp wire may be attached near the occlusal end of the outer caps and passed down to the saddle with three or four loops along its length, to firmly secure the vulcanite to the saddle, as in Fig. 588.

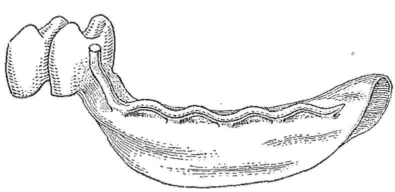


Fig. 588

Where caps, with tubes and split pins, are used as abutments, a loop of the half-round clasp wire may be run across the caps and back and over the saddle, as in the other case (Fig. 589). In either case, in using half round wire, the rounded side of the wire should be next to the saddle and caps.

For the attachment of the vulcanite to the sides of the saddle, the coin gold covering is well stippled. This will make a very strong attachment and one which will hold as well as any that could be devised. In stippling, a very sharp-pointed graver should be used, and it should be well and deeply stippled in both directions.

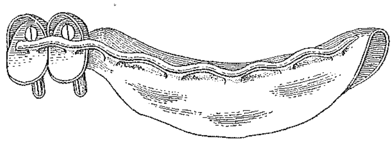


Fig. 589

This will make a very strong union, so that the vulcanite cannot be torn away. This will apply where the ordinary vulcanite pin teeth or the diatoric teeth are used.

Where Facings are Used with a Gold Occlusal Surface.—In making the bridge where facings are used with a gold occlusal surface, it is better that the facings should not be ground to fit the saddle exactly, but should stand away from it for from one-thirty-second to one-sixteenth of an inch, as in Fig. 590. The object of

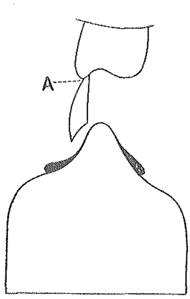


Fig. 590

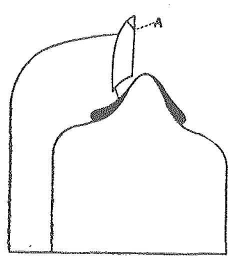


Fig. 591

this will be seen later. It is impossible to grind the facings so that they will fit the saddle so perfectly as to prevent foodstuffs or saliva from working in beneath them. It makes no difference how much time is spent doing it, and even though the joints are made very close, they will not be so after soldering. The tips of the facings should be high enough to touch the lingual surfaces of the buccal cusps of the occluding teeth, as in Fig. 590 *a*.

After the facings have been ground, they are held in place with wax on the lingual side, and a wall of plaster built up on the buccal side nearly to the occlusal ends of the facings, so as to retain them in position after the wax has been removed (Fig. 591). The facings are then removed and the occlusal ends ground off at an angle of about forty-five degrees with the backs or lingual side, as in Fig. 590 *a*, leaving them of sufficient length so that they will clear the occluding teeth by about from one sixty-fourth to one thirty-second of an inch. This angle should be the same on all the facings, and the line on which they are ground should be continuous, one following the other as though they had all been attached together and

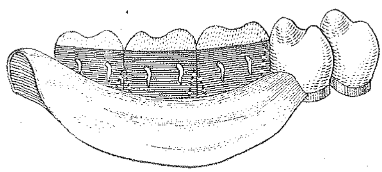


FIG. 592

then ground (Fig 592). It will spoil the appearance of the piece if they are ground unevenly, so that the tip of one is higher than the other, one standing up and the other down and it will look as though the piece had been thrown together haphazard, without care for artistic effect (Fig. 593).

The facings are then backed with thin platinum, the backings touching or overlapping each other slightly and extending from the beginning of the bevel at the occlusal end to the saddle, which they should touch closely all along, being carried straight down on a line with the backs of the facings (Fig. 592). The pins are then flattened and bent upward or downward, pressing on the backings to hold them tightly against the facings.

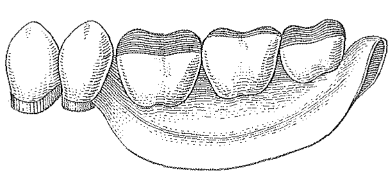


FIG. 593

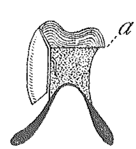


FIG 594

The facings are then waxed firmly to the saddle with hard sticky wax, the wax being carried high enough to support and hold the cusps but not flush with the lingual side of the cusps (Fig. 594).

Cusps.—Solid gold cusps are used, and they are selected and made in the same manner as are the cusps for a shell or telescope crown. The buccal side of the cusps are ground, or filed to a bevel to fit the bevel of the facings (Fig. 594). As each one is fitted, it is waxed lightly in place until they are all in position.

They are then ground or filed away on the lingual side so as to even them and not have one cusp broader or standing further lingually than the other. They should also be filed on a slight angle so as to follow the line of the lingual side as it will be when it is completed. This will give a broad point of contact for the lingual plate when in position and in finishing there will be no danger of grinding through into the hollow space on the inside of the bridge (Fig. 595). If the cusps were not beveled in this manner, the edge of the cusp coming down as it does to a sharp angle, it can be seen in the illustration (Fig. 596) that the point of contact

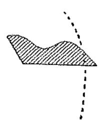


Fig. 595

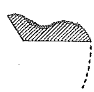


Fig. 596

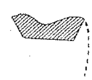


Fig. 597

would be but slight and if it were ground off a very little in finishing it would break through into this hollow space beneath. If the cusps were overbeveled, or cut under, the effect would be practically the same (Fig. 597).

After they have been ground and fitted, they are attached firmly with hard, sticky wax, but the wax should not extend to the lingual edge of the cusps. After they have been attached, the small end of the wax spatula is heated a little and passed under the cusp and raised slightly (Fig. 594 *a*), lifting the cusp on the lingual side so that on the buccal side the beveled edge of the cusp and facing will touch lightly at the tip, but there will not be actual contact at the lower or inner side of the bevel. The buccal and lingual sides of the bridge are now ready to be finished.

Waxing and Carving for the Plates.—The buccal and lingual sides are covered with wax, making the lingual side more than flush with the lingual side of the cusps so as to have plenty of stock for carving. The pink paraffin and wax is preferable, as it is fairly hard, is not sticky, and carves nicely. Both sides are then carved to represent the natural gums. On the buccal side it should be carried a little above the lower edge of the facings and well up between them, as in Fig. 598. On the lingual side, the carving is made continuous with the lingual angle of the cusp, as in Fig. 599, and the carving should correspond in depth and breadth to the facings on the buccal side.

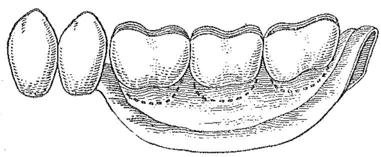


Fig. 598

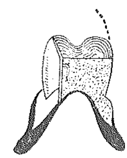


Fig. 599

The carving should be carefully done and the surface of the wax made perfectly smooth, in order to insure the obtaining of a clean die so that when the plates are struck up they will be perfectly smooth and when the bridge is completed, they will require no finishing other than with the pumice and rouge.

An impression is then taken of each side separately, the plaster being carried from below the saddle to above the gum line and over the heel on the buccal side, as in Fig. 600. On the lingual

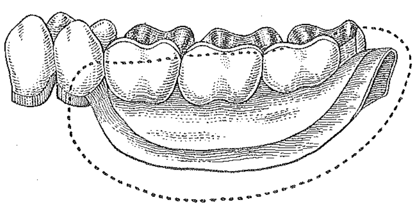


Fig. 600

Fig. 601

side, the plaster is carried above the cusps and below the edge of the saddle (Fig. 601) and far enough over the heel to meet or overlap the impression from the buccal side.

If zinc and lead dies and counter dies are to be used, a model should be poured into the plaster impression, as owing to the shrinkage of the zinc it is desirable that the face of the die should present the face of the carved facings and not the reverse side. If, however, fusible metal is used for the die and counter, the impression may be made deep enough to serve as a model, as with this metal there is practically no shrinkage and it will make no difference whether the face of the die presents the cameo or intaglio

(Fig. 601). These models should be at least one inch in depth so that there will be no sagging or springing of the die in swaging.

Where fusible metal is used, the sides of the model should be made nearly parallel so that the dies will be of that shape. The

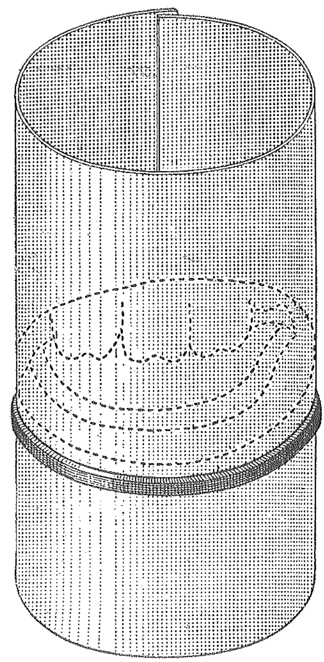


Fig. 602

mould may be made of sand, or preferably of Dr. Gritman's calcar,[1] and the fusible metal poured in this. It will only be necessary to get one die for each side from a calcar mould, as all the other dies and counter dies which are needed can be secured from the original casting.

The metal should be poured in the mould when it is not in a very liquid state, but it should be hot enough to allow it to pour fairly freely. This die is then chilled and wrapped in paper and a gum band placed around it, as in Fig. 602. The sides of the die being parallel makes it of a good shape for pouring the counter die. The die is then dusted with talcum powder and the counter

[1] Marble dust, moistened with glycerin and water, is cleanly, and takes the place of molding sand.

die poured. In pouring the counter die, the metal should be as cold as it is possible to pour it. It is poured into the paper on the die until it is about the same depth as the die itself.

After it has become chilled, it is readily separated and another counter poured from each of these. By wrapping in paper and dusting with talcum powder, in the same manner as in the first operation, any number of dies and counter dies can be secured and everyone will be an exact duplicate of those just made.

If the die is chilled and the counter die poured as cold as it can be made to flow, they will not stick, but will readily separate. As a rule, two dies and counter dies will be sufficient for swaging the plate, especially the buccal which is thinner than the lingual plate but for the lingual side it is sometimes well to use three as a sharper outline will be obtained in the plate than if only two had been used.

The dies and counter dies made, the buccal plate is struck up from No. 30-gauge coin gold, festooned carefully to fit around the facings accurately and carried over the heel of the saddle to about two-thirds the width of the cusp from the buccal side. The lingual plate is struck from No. 28-gauge coin gold and carefully fitted, the part going over the heel being brought in contact with that from the buccal side. The plates should be cleansed in nitric acid after each swaging and before they are trimmed or annealed, otherwise one heating after swaging, would entirely destroy them.

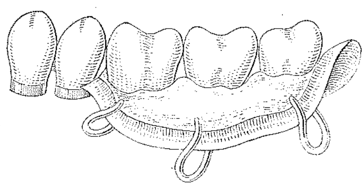


Fig. 603

After the final swaging, and when the plates have been thoroughly cleansed in acid, the pink wax is removed from around the facings and the saddle on the buccal side. The buccal plate is placed in position and held with small iron clamps, as in Fig. 603, two or three clamps being sufficient for the purpose. The saddle is then held over a small alcohol flame for a moment, or a hot instrument is held beneath it, to loosen the wax from the plate, and the teeth, with the body of the wax, are removed and laid carefully aside (Figs. 604 and 605).

Investing the Saddle.—The inner caps are removed and the saddle is invested, lingual side down, only enough of the investment being used to keep it from springing (Fig. 606). The inside of the caps are filled with investment, care being used not to allow the investment material to come over the part which is to be soldered.

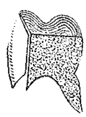


Fig. 604

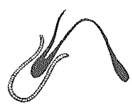


Fig. 605

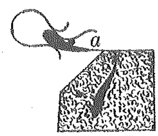


Fig. 606

The investment should then be thoroughly dried out, the piece well fluxed between the plate and the saddle and some pieces of 18-carat solder dropped in where the saddle and the plate are to be united (Fig. 606, *a*). The investment is then well heated up and when it has reached a red heat, the blow-pipe flame is thrown on the underside of the saddle next to the investment and the solder drawn through from the inside all around.

As the solder begins melting at one point, the flame of the blow-pipe is moved along slowly from end to end until the solder shows all along the outer edge, giving a perfect union between the plate and the saddle. Twenty-carat coin solder may be used for this purpose, but as the coin solder has a much higher fusing point than the 18-carat, a great deal more care is required in using, otherwise the buccal plate may be burned. In using the 20-carat solder, it is fed along and drawn in from the outer edge, using the solder in a strip. However, as the solder will not show at this place, it is safest to use the 18-carat.

After the investment has been allowed to cool the saddle is removed, cleansed in acid and dried. The saddle is then warmed slightly and the body of the bridge (Fig. 604) is pressed back into place until the fitting of the lingual plate shows that it is in its correct position. The bridge is now ready for the final soldering.

Soldering the Body of the Bridge and the Lingual Plate.—In all soldering operations, cleanliness is absolutely essential, and there is no greater enemy to the free flowing of solder than is plaster-of-Paris. Cleanliness is especially needful in soldering a bridge of this character, as such a high degree of heat is required to make the solder flow in places which are deep down in the body of the bridge, that, unless perfect cleanliness is obtained, there is a great liability of burning the exposed parts. All of the parts which are to be soldered should be covered with wax before investing. The investment having been mixed it is placed on the slab to the depth of about one-half of an inch. The bridge is laid buccal side down on this and worked into it for perhaps one-eighth of an inch by using a slight pressure on the lingual side, agitating it slightly, and keeping the edges of the cusp and the lower edge of the saddle on a level.

With a small instrument (the curved end of the small wax spatula is suitable) the investment is worked up so as to cover a little more than one-half of the cusps and over the labial side of the saddle so as to cover about one-half of it, leaving the lingual half of the saddle and the lingual third of the cusps exposed, as shown in Fig. 607, *a a*.

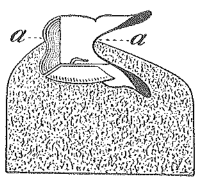


FIG. 607

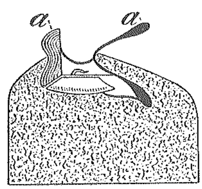


FIG. 608

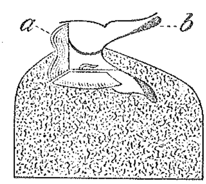


FIG. 609

Before the investment has thoroughly hardened, it is trimmed to the proper size and should be kept as small as possible, and still give support to the bridge. All of the trimming should be done at this time, before removing any of the wax. All the parts which are to be covered with solder should be cleansed, the plaster scraped off, and the nearby parts rubbed off with a damp cloth, or washed so that no plaster will remain. After the investment has hardened, it is warmed a little, to slightly soften the wax in contact with the different parts, and the bulk of the wax is lifted out, and the remainder can be washed out with boiling water.

It should then be dried out thoroughly with a gentle heat and a little powdered calcined borax sprinkled inside the body of the bridge. The piece is then heated up slowly until it is of a bright red heat and it is ready to solder.

Twenty-carat solder is first used at the mesial end to unite the saddle and cusps firmly to the abutments and then at the distal end, should there be an anchorage at that end, or should the cusp be attached to the end of the saddle. The solder is then flowed over the backings of the teeth and over the saddle and up to, and between the cusps so that all the exposed parts will show nothing but 20-carat solder. The backings of the facings should be covered to the depth of perhaps a thirty-second of an inch or sufficient to cover the pins of the facings and coming up on the saddle and the under side of the cusps, as shown in the drawing (Fig. 608). It is not necessary, nor is it desirable, that this space be entirely filled, as that would make the bridge entirely too heavy, but only enough solder is used to give the necessary strength to the piece. After this has been finished, the soldering of the lingual plate may be undertaken. The under surface of the plate at the upper and lower edges is well fluxed, using the liquid flux and applying a little at a time and passing it through the flame to dry it off. The lower edge of the saddle and also the lingual sides of the cusps at point *a* and *a*, in Fig. 608, are then fluxed and a little 18-carat solder is flowed over these points throughout the length of the bridge. Solder is best used in a strip in applying it to these points.

The piece is then well heated up and the lingual plate placed carefully in position (Fig. 609). The whole bridge is brought to a bright red heat, a brush flame being used until the solder begins to melt, when a pointed flame should be used, passing it along the upper side, throwing the flame on the cusps (Fig. 609, *a*), and moving from one end of the bridge to the other until the solder has drawn through at every point and the plate united firmly to the cusps. If there are any points where the plate has not quite dropped into position, a pair of pliers may be used, one beak grasping the plate where it is not in exact contact, the other beak being on the underside of the investment, as in Fig. 610, *a*, and as the solder flows, the plate can be pressed in contact with the cusps, as it will bend very easily under heat.

The occlusal side of the plate being properly attached, the operator's attention is next turned to the lower side. The piece is reversed so as to bring the lower edge of the saddle toward the operator, and the flame is thrown on the under part of the saddle (Fig. 609, *b*), which is heated until the solder draws freely from the inside and has flowed along the whole length of the saddle. If it stands away at any point, it should be brought together with the pliers while the solder is molten, until it is in perfect contact all around (Fig. 610, *b*). Over the heel of the saddle, where the buccal and lingual plates come in contact, a little solder should be flowed until the two plates are perfectly united.

Twenty-carat solder may be used for soldering on the lingual plate by first fluxing the cusps and the lower edge of the saddle and then placing the lingual plate in position. The solder is used in a strip and a small amount placed at a point of contact of the plate with the cusps, tacking it a little at first, and then feeding the solder

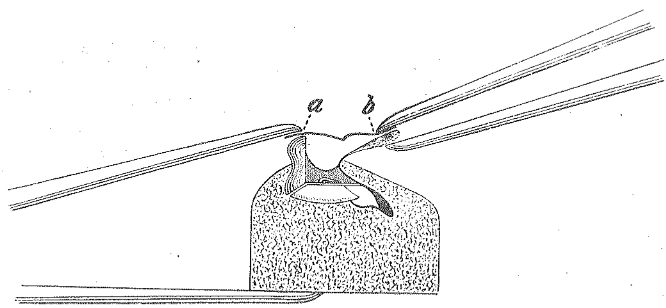


Fig. 610

in and moving it along slowly from one end of the bridge to the other. The lower side of the plate is now attached to the saddle in the same manner, feeding in the solder in a strip, and gradually drawing it through from one end to the other, after which the ends of the buccal and lingual plates, which come together over the heel of the saddle, are soldered.

The 20-carat solder is of a so much higher fusing point than the eighteen that it is safer to use the 18-carat unless the operator is an expert in the use of the blow-pipe. If, however, the plate has been carefully fitted, the line of solder at the point of union of the cusp with the plate is so fine that the difference in the color will not be noticeable. The greatest care must be used in soldering on this plate and the pointed flame should not touch it as the piece is necessarily brought to such a very high heat that the lingual plate can be burned in an instant, thus destroying it, and necessitating making a new one.

After the bridge has cooled it is removed from the investment, boiled in dilute sulphuric acid and washed in a solution of bicarbonate of soda and then rinsed in clear water. It is next dried as well as possible and then dipped in alcohol, or alcohol poured over it, and then again dried thoroughly, so that before any finishing is undertaken, there will be no moisture in any part, as should there be any moisture present, the dust of the grinding will work in the crevices and the spaces between the plate and facings, leaving dark lines which will present a very disagreeable appearance This applies to the finishing of all bridges or crowns.

The bridge is then finished, first using fine carborundum wheels and grinding away any edges of the cusps, which may overhang the facings, until they are perfectly flush with the facing.

In grinding the cusps the grinding should always be done from the gold to the porcelain, thus burnishing the gold over the facing and making perfect joints. By so doing there will be no danger of fracturing the thin edge of the facing. On the contrary, if the grinding is from the porcelain to the gold, the fine edge of porcelain at that point will be shivered, making it rough, and impairing the beauty of the work.

On the other side, the lingual plate is ground flush with the cusps and the lower edge of the saddle on both buccal and lingual sides are smoothed and rounded. It should not be necessary to touch either the lingual or buccal plates with the stone, if care has been used in obtaining smooth dies, and the plates have not been marred in swaging. The heel of the plate is finished with carborundum stones and afterward all of the parts which have been ground are smoothed off with sandpaper, or emery disks, and then cuttlefish, so that there will be very little finishing to do on the lathe.

The piece is now placed on the model and articulated and the cusps are carved as desired.

Filling Beneath the Buccal Plate with Cement.—The next step, before the final polishing of the piece, is to fill the buccal side with cement. One of the points of the buccal plate, which has extended up between the facings, the point most nearly central should be used, is thrown out from between the teeth a little, sufficient to allow of the insertion of the point of a cement syringe (Fig. 611), and oxyphosphate of zinc, mixed fairly soft, should be forced in between the plate and the saddle and facings, filling the space. The cement should be forced in until it can be seen working its way out at both the mesial and distal ends around the necks, between the facings and the plate. While the cement is still soft the point which has been thrown out to allow for the entering of the syringe point, is pushed back into place between the facings.

After the cement has hardened, the excess should be cleaned away from around and between the teeth. The spaces between the teeth are now partially filled in with gold, a plastic gold will be found best for this purpose, and carried over the points of the plate which extend up between the facings. The spaces should be filled so as to enable them to be smoothed nicely and also to obliterate any crevices or spaces which might serve as a lodgment for foodstuffs. The fillings are then smoothed and the bridge is finally polished.

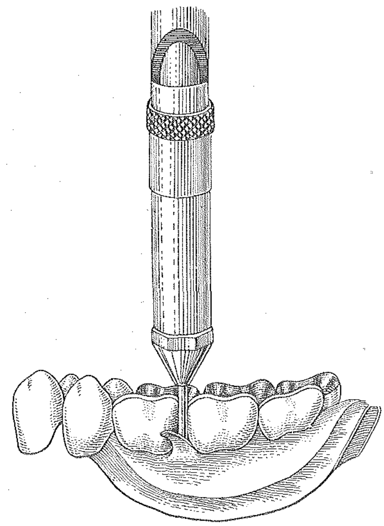


FIG. 611

Polishing the Bridge.—A felt wheel with pumice may be used over the surfaces, which it has been necessary to grind, but over the buccal and lingual plates a fine brush wheel, with a little fine pumice, may be used for just a moment. Small leather wheels mounted and used in the engine can be used in the small places. After the bridge has been washed, the rouge is applied. This can be used over the larger part of the bridge on a felt wheel, but over the fluted and uneven surfaces of the plates and the fillings between the teeth, the rouge should be used on a fine brush wheel, and the whole polished until the surface is smooth and highly finished.

SADDLE BRIDGES. ABUTMENTS AT BOTH ENDS.

Where there is an abutment at each end of the saddle, the bridge is made in practically the same manner as the extension bridges.

In the anterior part of the mouth, the saddles are struck up and the relation, as in the case already described, of the saddle with the abutments, is secured with the saddle under pressure. Where it is possible to do so, the facings are ground flush with the gum, the saddle coming only to the lingual side (Fig. 612), but where there is great depth from the gum to the incisal edge of the teeth and where the lip is long and it is not possible to see the gum, or where greater fulness is desired, the saddle may be extended over

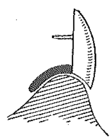


Fig. 612

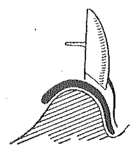


Fig. 613

the ridge and made in practically the same way as the extension saddle already described, a labial plate being swaged and fitted around the teeth and connected to the saddle as are the buccal plates to the saddle previously described (Fig. 613).

The facings are then backed and soldered in the usual manner, and the lingual sides carved and finished as desired.

There are cases where there has been great recession and shrinkage of the process and tissues, when it may be necessary to use single gum teeth, and in these cases the teeth are ground in the usual manner, the saddle coming in contact with the lingual sides of the teeth.

In other cases, detachable facings may be indicated, the gum contour can be restored by building out with porcelain gum body, and the whole cemented after the bridge has been soldered and completed, but no rule can be laid down covering the adaption of these different styles of work, each must be decided by the individual requirements of the case.

CHAPTER XV.

RETAINING MEDIA.

The zinc oxyphosphate employed in the setting of crowns or bridges should possess the characteristics which would recommend the specimens to be used as filling material, and should be what is known as a hydraulic cement. It should, however, flow freely, and, as the difficulty of maintaining dryness is increased, it should set promptly and yet with sufficient deliberation to permit of the accurate adaptation of the crowns.

The operator should be familiar with the peculiarities of the particular cement he is using, as specimens of the different makes of oxyphosphate differ so markedly in their behavior, that it is unsafe to use them for this purpose without having first tested them.

The value of a cement depends as much, perhaps, upon the manner in which it is mixed as upon the kind of cement which is used. The cement should always be thoroughly spatulated. A little of the powder should be first well worked into the liquid, a very little of it being dissolved during the process. The powder is then added a little at a time, mixing it well until enough has been incorporated to give it the desired consistency and the whole mass is perfectly smooth and creamy.

The spatulas used should be strong and of ample size to do the work thoroughly. Fig. 614 shows a spatula suitable for single crowns or small bridges, but for large bridges, with several abutments, where a large mix is required, a spatula such as shown in Fig. 615 or one even larger, is indicated. In this case a large slab should be used. A piece of plate glass about four and a half inches by six inches will answer nicely and is none too large.

Setting Crowns with Oxyphosphate of Zinc.—It is advisable to set all pin crowns so that they can be taken off without mutilation, if at some future time it should be desirable to do so for the purpose of repairing them, or in case they should be needed as anchorages for a bridge. An excellent method of setting them so that they will be perfectly rigid and at the same time be easily detachable, is first to give the pin and the inside of the cap and band a thin coating of chloropercha. A convenient way to do this if a solution is not at hand, is to take a fine camel-hair pencil, dip it in chloroform and then rub it on base-plate gutta-percha and paint the cap and pin with this extemporized chloropercha. The solution will dry very quickly and the crown is then set in the regular way, with oxyphosphate of zinc. If at any time it is desired to remove the crown, it can be easily done with a pair of heated forceps or pliers.

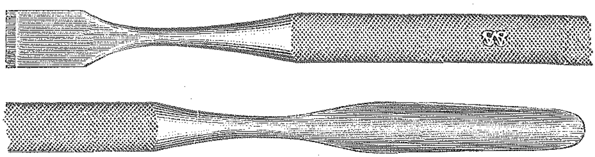


FIG. 614

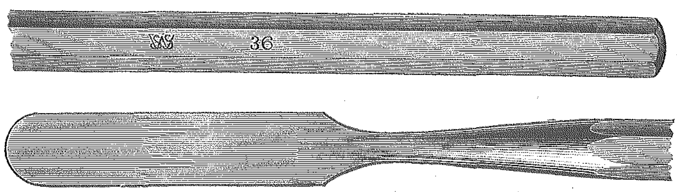


FIG. 615

CEMENTING BRIDGES IN THE MOUTH.

In nearly every case, whether a bridge be fixed or removable, it is better that it be worn in the mouth without cementing for at least from twenty-four to forty-eight hours. This will allow it to adjust itself and settle in place and render the cementing of the piece easier.

Cementing Fixed Bridges.—After the bridge has been worn for a time and removed from the mouth, it is first thoroughly cleansed. After washing well with soap and water and a brush, it is dried and the inside of the abutment caps washed with nitric acid, after which it is again washed with water and dried with alcohol.

The abutments in the mouth are then cleansed and it is a good plan, especially if the piece has been worn for some time without cementing, to clean them first with pumice, using a small brush on the engine, afterward rinsing the mouth well. In keeping the mouth dry, napkins are preferred to cotton rolls as the latter are so fibrous that some of the fibers may make their way over the abutments and when the caps are cemented, a few fibers might allow for the entrance of moisture and so eventually cause trouble.

The napkins are placed so as to keep the field of operations as dry as possible. The teeth and canals are first wiped with a solution of bichloride of mercury and peroxide of hydrogen and dried off. If there is any tendency to bleeding, the gums may be wiped with adrenalin chloride. They are then washed with alcohol and thoroughly dried again with hot air or a root drier.

Fig. 616 shows the Evans root drier. It consists of a copper bulb through which is passed a silver or copper point. A handle is screwed into this holding the point firmly in place. The copper bulb is heated in the flame and the heat is transmitted to the end

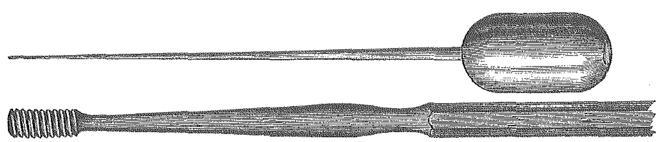


Fig. 616

of the point which is placed in the canal, drying the root out quickly. A fine point is used when the entire canal is to be filled, but a heavy one can be used to dry out the canal where a crown is to be placed on the root.

The cement is now mixed and if the canals are to receive a post these are first filled, a cement syringe is here indicated, and then the caps on the bridge are filled full of cement and the bridge is pressed firmly in position in the mouth. The napkin is then removed and the patient is instructed to close the teeth, and the mouth is carefully examined to ascertain that the bridge is in its proper position. If everything is all right, the patient is told to keep the teeth closed without the slightest movement of the jaws and this position should be kept for at least ten minutes. Sometimes it will make it easier for the patient if the operator or his assistant holds his hand under the chin, pressing it upward during the setting of the cement. At the end of from twenty minutes to one-half hour, the excess cement can be removed from around the edges of the caps, the gums wiped off with some soothing preparation and the patient dismissed.[1] Another appointment should be made for twenty-four or forty-eight hours later when the mouth should again be carefully examined to see that everything is as it should be.

[1] Campho-phenique is excellent for this purpose.

The patient may again be seen a couple of times at intervals of a week or two before being finally dismissed.

Cementing Removable Bridges.—In cementing removable bridges, the work is done in practically the same manner as in the case of a fixed bridge. The piece is worn for a time and when removed is thoroughly cleansed, the inner caps being removed and cleansed in nitric acid. After cleansing, the inner caps are put back in place in the bridge and film of pink paraffin and wax run around the edge of the outer caps where they overlap the inner caps. It should be run on quite hot so that it will stick well, and on the anterior, where porcelain crowns or facings have been used, the line between the half-band and inner caps should be well covered and also on the labial side between the outer and inner floors. Great care must be used not to get any of the wax on the inside of the inner caps. If this happens, it must be carefully removed before cementing. The object of waxing the bridge so carefully in this manner is to prevent the possibility of any cement working in between the outer and inner caps and so making a fixed bridge out of a removable one.

The bridge being thus prepared, the remainder of the work of cementing is done in exactly the same manner as for a fixed bridge. After cementing, the teeth are kept firmly closed for fifteen or twenty minutes and then the bulk of the excess is removed, but it is not removed from around the gum margin at the edge of the caps at this time. The patient is dismissed and another appointment made for the following day or several hours later the same day when the bridge is removed, the inner caps remaining firmly cemented to the abutments. The wax and excess cement is now carefully removed from around the caps and from beneath the gum and the gum wiped with campho-phenique.

The patient is instructed in removing and replacing the bridge and dismissed with instructions to remove the work at stated times for cleansing. The patient should be seen frequently for the first few weeks to see that everything is all right. They should always report at intervals of from four to six months for examination and by so doing, the work can be watched and kept in perfect condition for many years.

Cementing Inlays for Removable Bridges.—Where inlay abutments are used as attachments for removable bridges, the inlays are cemented separately. This is the only instance in removable work where the parts are not assembled and the whole treated as a fixed bridge. The bridge is worn for a time without cementing and then the inlay is removed and thoroughly cleansed and cemented in place, being held under pressure until the cement has hardened. The excess cement is then trimmed away and the inlay is finished and polished. The balance of the bridge is then treated the same as a fixed bridge. Wax flowed between the outer and inner caps and everything cemented in place.

The reason the inlay of a bridge of this kind is set separately is that there is only one way for it to go, and that is the right way. If it should happen to be twisted the least bit one way or another, it would clear the margins of the cavity at certain points, thus leaving a line of cement exposed, but if it is set separately, this can never happen.

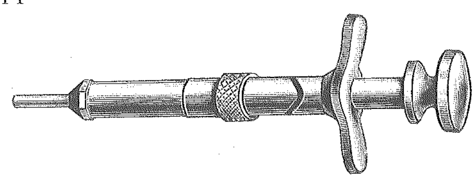


FIG. 617.—About two-thirds actual size.

The cement syringe shown in (Fig. 617), is a most useful aid in cementing crowns or bridges, especially where several pin crowns, either single or as abutment pieces, are to be set at one time. The syringe consists of a nickle-plated brass cylinder or barrel with a needle or tube small enough to enter the enlarged canal, and a nickle-plated brass plunger. There is an opening in the side of the cylinder for the introduction of the cement. The root is thoroughly dried and the cement mixed to the consistence of thick cream and placed in the cylinder. The piston is then put in the barrel and the end of the needle carried to the end of the canal and the cement forced into it, at the same time withdrawing the needle slowly. In this way, the apical extremity of the canal is filled first. A number of roots may be filled in this manner in a few seconds and there will be ample time to put the crowns or bridge in place before the cement has set.

As soon as the piece is in place, the syringe is plunged into a basin of cold water and the piston worked back and forth to free it from the remaining cement while this is still soft. It is also well to rinse afterward with a solution of bicarbonate of soda so that any remaining particles of cement may be easily removed. If the cement is too hard to be forced out, it may be removed with the drill which comes with the syringe for this purpose.

SETTING CROWNS WITH GUTTA-PERCHA.

When gutta-percha is to be employed, it is necessary that the several parts shall be at a temperature which will permit the ready, deliberate, and accurate adjustment of the crown and gutta-percha to the root.

The crown is laid upon a gutta-percha heater. Dr. How's steatite slab is useful for the purpose (Fig. 618), or in the absence of this appliance, it may be heated over a small alcohol flame. A piece of base-plate gutta-percha is also laid on the slab, or heated over the flame of the lamp, and when soft is pressed out between the fingers into a sheet, which is wrapped around the heated post.

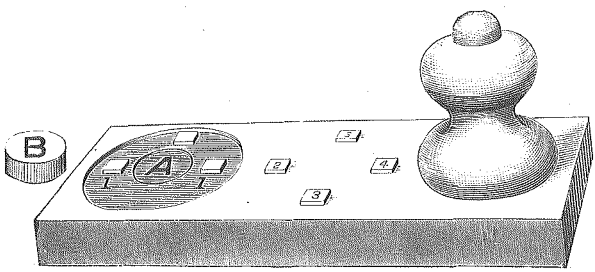


Fig. 618

The canal is moistened so that the crown may easily be removed and the crown forced on to the root as far as possible. It is then removed and the surplus gutta-percha, which has been squeezed out around the edge of the band, is removed, after which the canal is again moistened and the crown heated and pressed into place. This is repeated until the crown goes up to its normal position. It is then removed and cleansed and dried with alcohol and a very slight excess of gutta-percha is placed around the pin. A napkin is now placed in position to keep the field of operation dry and the canal is dried thoroughly and then wiped out very lightly with one of the essential oils, preferably eucalyptus. The crown is now again heated and forced up into place. Any excess of gutta-percha which may have been squeezed out over the margins of the crown is removed, and the work is completed.

If the above instructions have been carefully carried out, a crown set in the manner described will be as permanent, and give practically as good results as though set with oxyphosphate of zinc and at the same time possesses the advantage of easy removal, should this be desired.

CHAPTER XVI.

REPAIRING CROWNS AND REPLACING BROKEN FACINGS.

Removing Shell Crowns.—When, for any reason, it may be found necessary to remove a full gold crown from a tooth, if the crown has been properly fitted and cemented, it will generally be necessary to cut the band in order to get it off. This may be easily done with one of the crown slitters which are made for the purpose, as illustrated in Fig. 619. With one beak resting on the cusp and the other caught under the gingival edge of the crown, the forceps are closed, dividing the band all of the way to the cusp, when by giving a slight rocking movement, the crown may generally be easily lifted off. Should this not be the case, an instrument is passed under the flap and worked around the tooth to loosen the cement and the band gradually worked free (Fig. 621). A hatchet-shaped excavator can often be used to do the cutting, the blade being repeatedly drawn from the cervical edge to the cusp, until the band is divided. A small wheel bur will do the work, cutting from the cervix to the cusp in the same way as with the excavator.

One of the best instruments for use as a crown slitter is one which was not designed for the purpose. This instrument is the old Physick forceps, used in the extraction of lower third molars (Fig. 620). The edges at the end of these beaks should first be sharpened and it is then ready for use. It is almost universal in its application and either beak is used for cutting. One of the beaks is placed on the occlusal surface of the crown and the other over the gingival edge and the band is split by closing the forceps.

Repairing of the Shell Crown.—In repairing the shell crowns, the cement is first thoroughly removed and if it should happen to be one made by the operator and a sweated crown throughout, the edges can be brought together, a small strip of coin gold placed over it and melted in place. In making a repair of this character, the crown should be placed on a piece of charcoal with the cusp toward the operator. The flame of the blow-pipe is then thrown on the cusp until the whole crown is entirely heated-up nearly to

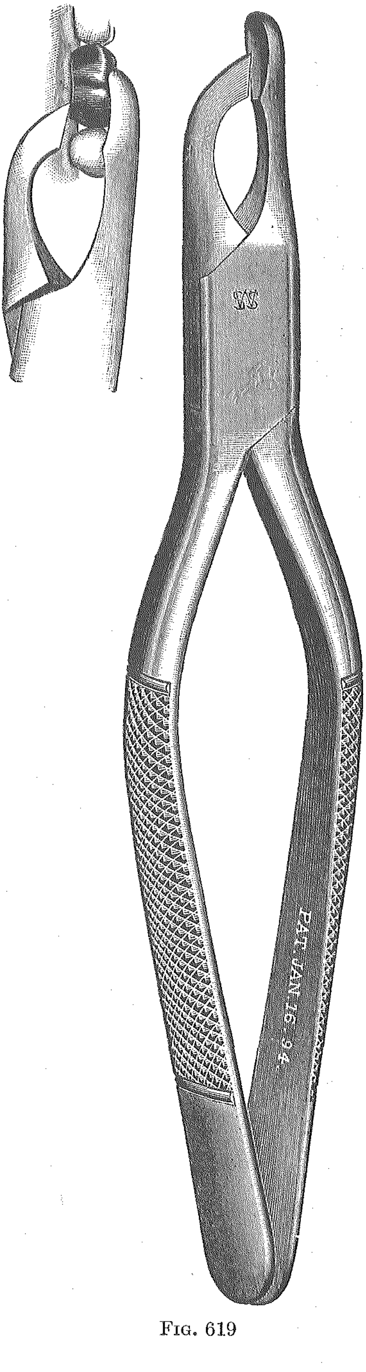


Fig. 619

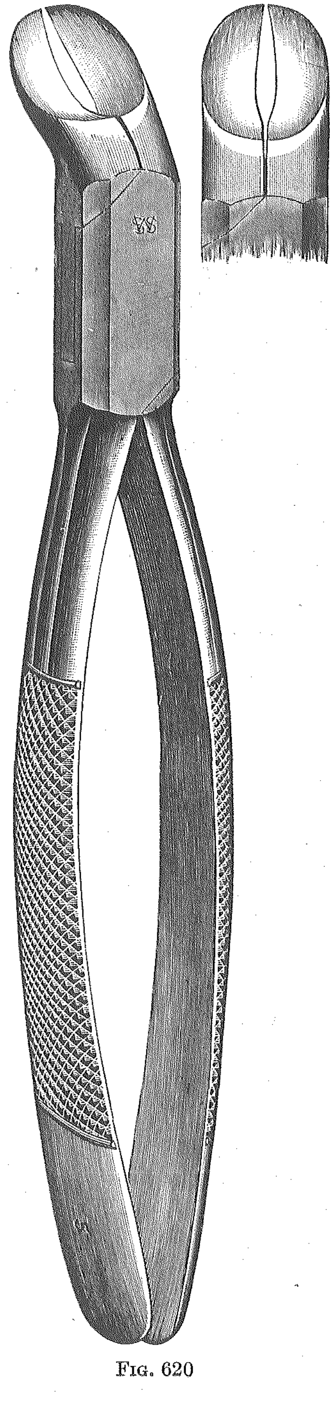


Fig. 620

the melting point, when the flame is flashed across the break and the coin gold melted over it (Fig. 622).

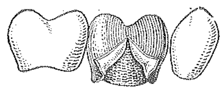


Fig. 621

If it is a soldered crown and there is no loss of material, the edges are simply brought in contact and solder flown over it. If

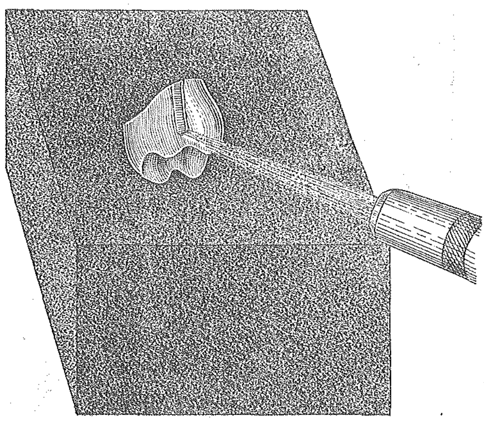


Fig. 622

there has been much loss of material at the sides of the cut, a narrow strip of thin platinum or of pure gold is waxed over the

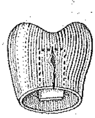


Fig. 623

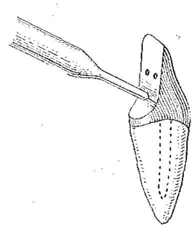


Fig. 624

line of division on the inner side of the cap which is then filled with investment material, dried out and the broken part covered with solder (Fig. 623).

Removing of Porcelain or Porcelain-faced Crowns.—The removal and repairing of a porcelain-faced crown is a more difficult operation than of a shell crown. If the crown has been set with gutta-percha, it may be easily removed by grasping it with a heated pair of pliers, or forceps, having first protected the lips and gums of the patient with napkins. It is well to try this method first on a chance of gutta-percha having been used. If it has been set with oxyphosphate of zinc, much more trouble will be experienced in getting it off. It will be necessary first to separate the cap from the pin, which may be done by passing a drill from the labial side through the base of the backing at its junction with the floor of the cap to one side of the pin and then cutting the pin through with a very small fissure bur, after which the cap is easily pried off (Fig. 624).

Removal of Post.—There is on the market an instrument designed for removing a post from the root consisting of a pair of jaws which grasp the post, while another pair rests against the end of the root. When the pin is tightly clamped, a screw at the end of the instrument is turned, and if the post is not very long or has not been well cemented it can be removed without difficulty (Fig. 625). Where, however, the pin is long and has been well

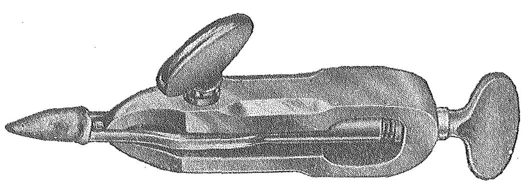


Fig. 625.—Little giant post-puller.

cemented, it will be necessary first to cut away the cement from around it until it has become somewhat loosened, then the instrument may be used to remove it.

In the absence of one of these instruments, the work can generally be done within a short time by other means. The cement is first loosened from around the pin with a very fine spear-pointed drill. The shank of one of the finest burs or of a Gates-Glidden drill, flattened on two sides and then ground to a spear point makes an excellent drill for the purpose, being smaller than any obtainable at the dental depots. The cement is drilled away close to the pin all around, inclining the drill toward the post at all times so as to lessen the danger of a perforation or a possible weakening of the root by cutting into it (Fig. 626, *a* and *b*).

From time to time an effort may be made to loosen the pin by grasping it with a pair of strong, narrow-nosed pliers and trying

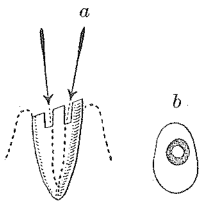


FIG. 626

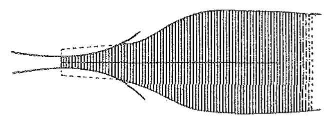


FIG. 627

to rotate it. The pin roughing and bending pliers may be used for the purpose. Very often the nose of the pliers is somewhat blunt, but it may easily be reduced by grinding (Fig. 627).

If the pin does not loosen, the drilling should be carried deeper until it can be removed. The remainder of the cement is then removed from the canal with a reamer and a new pin fitted to it. The palatal portion of the crown with the backing should then be cut away the cap placed on the root and a new pin waxed in place. The cap and pin are now removed, invested and soldered, after which the facing is ground, backed and the crown soldered.

REPLACING BROKEN FACINGS ON FIXED CROWNS OR BRIDGES WITHOUT REMOVING THE APPLIANCE FROM THE MOUTH.

There are several different methods of replacing a facing without removing the cap and pin from the root. A good way, and one which makes one of the strongest repairs that can be made, where the remaining metal portion of the crown is of sufficient thickness, is as follows: The remnants of the tooth pins are first removed and ground flush with the backing, and an impression taken covering the backing and floor of the cap, and a model made of plaster, cement or Spence metal. A hole is then cut in that face of the model representing the backing, against which the new facing is to be fitted, large enough for the pins to enter freely (Fig. 628). The facing is then selected and ground to fit the model accurately. The backing of the crown in the mouth is then cut out to accommodate the pins, care being used not to break through on the lingual side. The cavity is then deeply undercut all around, making it strongly retentive in shape (Fig. 629, *a*, *b* and *c*). Fig. 630, *a*, being

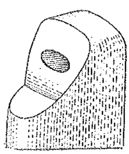


Fig. 628

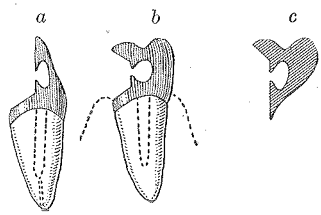


Fig. 629

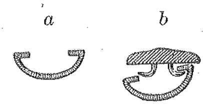


Fig. 630

a horizontal cross-section of the backs. The pins of the facing are flattened at the ends and bent at right angles, one being cut a little shorter than the other so that when the long pin is inserted and the facing pressed as far to that side as it will go, the short pin will pass through the opening in the backing (Fig. 630, *b*). The facing is now removed and the cavity filled with cement, and the backing and floor covered. The long pin is first introduced, the facing carried to that side until the shorter one will enter. It is then pressed tightly in place and then forced back until the sides of the facing are even with the backing. This will bring the ends of both the short and long pins under the ledge of the cavity and when the cement has hardened, the facing will be so firmly held that it would be impossible to remove it except by breaking it (Fig. 631).

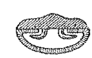


Fig. 631

Another method of repair without removal from the mouth is that of riveting the facing to the backing. This is one of the oldest methods, and also one of the best if it is carefully done. The pins are cut from the backing, an impression taken and a model prepared as in Fig. 628. The new facing is ground to fit the model. A backing of heavy tinfoil or paper is fitted to it and trimmed carefully to the edge of the facing all around. This backing is then removed and fastened in position over the gold backing of the crown in the mouth (Fig. 632). The holes in the backing will show the exact position of the pins of the facing, and the holes may be drilled with a small spear-pointed drill the exact size of the pins. The holes are then countersunk from the palatal side and the pins cut off so that they will project only a slight distance through the backing (Fig. 633).

The riveting is done with a plate punch. The facing is removed and the backing and floor of the cap covered with cement of about the same consistence as that used in setting a crown and the facing

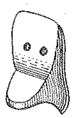


Fig. 632

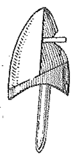


Fig. 633

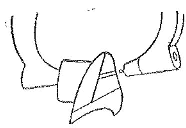


Fig. 634

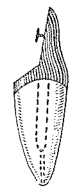


Fig. 635

placed in position. A piece of lead or a thickly folded napkin is placed over the facing, with the die side of the punch resting on this, and while the cement is yet soft, the pin is riveted by rubbing and burnishing with the punch end of the forceps until the countersink is entirely filled (Fig. 634). After riveting, any excess platinum of the pin may be ground away and the back polished. If the pins are carefully riveted, and the holes are not too large, this makes as strong a repair as can be made by any method. If the cement has been allowed to harden before the riveting is done it will be broken and will crumble away, and the repair will not be as satisfactory.

Another method of repair is as follows: The headed pins are left in the backing (Fig. 635) and the pins of the facing, which is to replace the one broken, are ground out and the holes dovetailed. This may be done by very simple and easily made instruments. The first requisite is a trephine for grinding out the pins. This can be made by using the shank of a bur, and filing it down at the end until the point is slightly larger than the tooth pin (see Fig. 636). On this is fitted a tube about one-half inch long, made of ordinary brush copper, No. 36 gauge. The copper is cut about one-half an inch wide, and rolled around a pin or mandrel about the size of the tooth-pin. It is rolled around twice so as to form a tube with sides doubled the thickness of the metal (Fig. 637, *a*). The end of the bur shank is then inserted into one end of this tube, and the whole fluxed with zinc chloride and soldered with ordinary tinner's solder (see Fig. 637, *b*).

Carborundum and glycerin should be used for grinding. The instrument is placed in the engine and the tube dipped in the carborundum and glycerin, and then placed over the pin and the engine started (Fig. 638). The instrument is raised and lowered, on the facing, as it revolves, allowing the abrasive powder and liquid to constantly work under it. This is kept up until the pin is entirely ground out. After the pins are ground out, the hole is dovetailed,

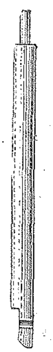


FIG. 636

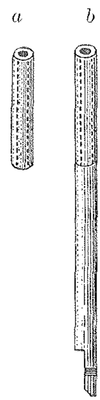


FIG. 637

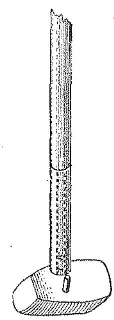


FIG. 638

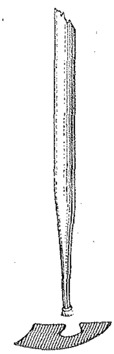


FIG. 639

which may be done by using an old wheel or inverted cone bur from which the temper has been drawn. This is dipped in the carborundum and glycerin and then placed in the hole and the engine run rapidly until the hole is well undercut all around (Fig. 639). The powder is then well washed out and the holes filled with cement. The backing of the tooth, which has previously been well dried, is covered with cement and the facing pressed into place and held there until the cement has hardened (Fig. 640).

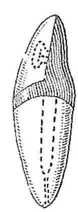


FIG. 640

This makes a quick and easy repair, but where great strength is required it is not as good as those already mentioned, as the facing has been weakened to a certain extent by enlarging the pin-holes.

Dr. Emory A. Bryant has a novel method of attaching a new facing. A tap and die, the size of the tooth-pins are necessary, together with a special countersinking tool and a screw-driver. The pins are cut from the old backing and holes the size of the pins of the new facing are drilled in proper positions. With the countersinking tool held in a right angle hand-piece, the holes are countersunk on the lingual side nearly to the outer wall of the backing. The nuts are made to correspond in size and taper with the countersink. By means of the oiled die, a thread is cut on each pin of the facing, and continued to the back of the facing, exercising great care that the pins are not twisted or stained. The backing is covered with cement, the facing set in position and each nut is loosely adjusted, then alternately screwed into place drawing the facing close to the backing. The protruding portions of nuts and pins are then ground flush with the backing and polished.

This method of replacing broken facings is very ingenious and will answer where there is little or no strain on the facing, but the cutting of a thread, on such a small pin, will weaken it to such an extent as to render it of little value where much strength is required. It is better if the full strength of the pin can be preserved.

CHAPTER XVII.

BRIDGE-WORK DESIGNED FOR RIGG'S DISEASE CONDITIONS.

By HOWARD T. STEWART, D.D.S.,
NEW YORK CITY.

The attachments partially illustrated below, is the outgrowth of the system of the split pin and telescope crown as taught by Dr. Peeso (in his construction of modern removable bridge-work), to whose teachings I owe my early inspiration.

On studying closely the crowns, we will see that the original idea of the split pin and telescope crown obtains through the entire work. Even the split bar is the suggestion of the split pin, and the "shoulder crowns" are a modification of the telescope crown.

This system was gradually worked out by the writer, in his efforts to adapt bridge-work to those conditions of alveolar inflammation where special care is required to produce permanent results.

As my own work differs to a certain extent as to the individual lines above referred to, from any other system, I am giving this in addition to what Dr. Peeso has already presented, in the hope of having it contribute somewhat to this characteristic individuality.

Fig. 641 illustrates attachments made of telescopes and split bars, also an adjustable *saddle*. This saddle is attached temporarily with gutta-percha or cement, removed and lowered as absorption of the ridge takes place. This prevents rocking of bridge and leverage on roots.

Fig. 642 is a full upper with rubber saddles. These saddles are sometimes made of rubber (always perfectly smooth and highly polished next to the gum), and as the ridge absorbs, wax is added, patient bites on it and more rubber is added. This can be reproduced in gold later.

The cuspid shows the usual tube in canal with a short tube swung off that just clears the gum. This makes a firmer locking device than the one pin.

The central is the usual tube slightly lengthened up into the body of crown.

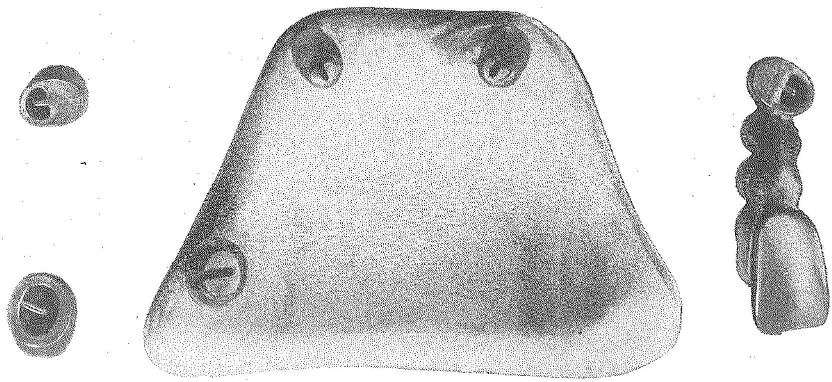


FIG. 641

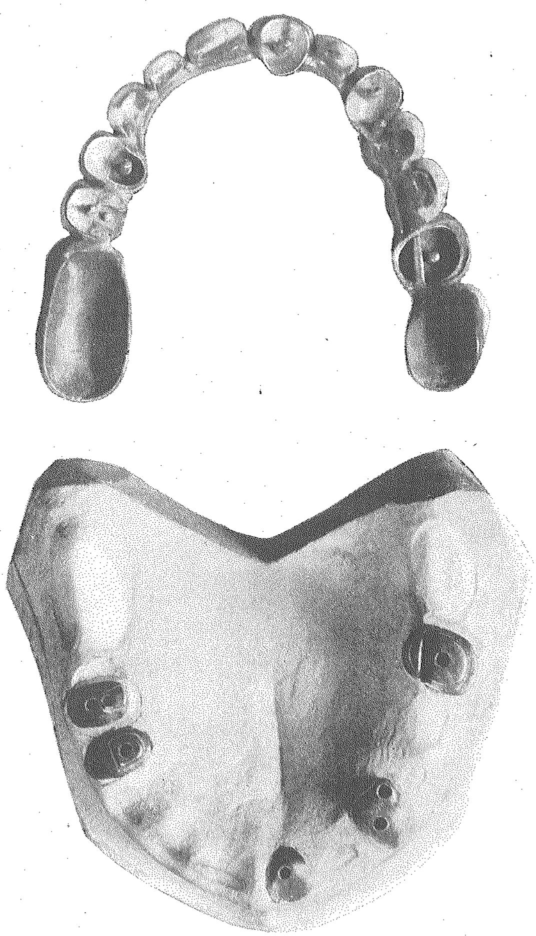


FIG. 642

The first bicuspid tube extends well into the crown, giving longer pin and additional strength and friction.

The second bicuspid shows one tube in the canal and one short tube stopping at the cap, this last tube being the length only of the box in the crown.

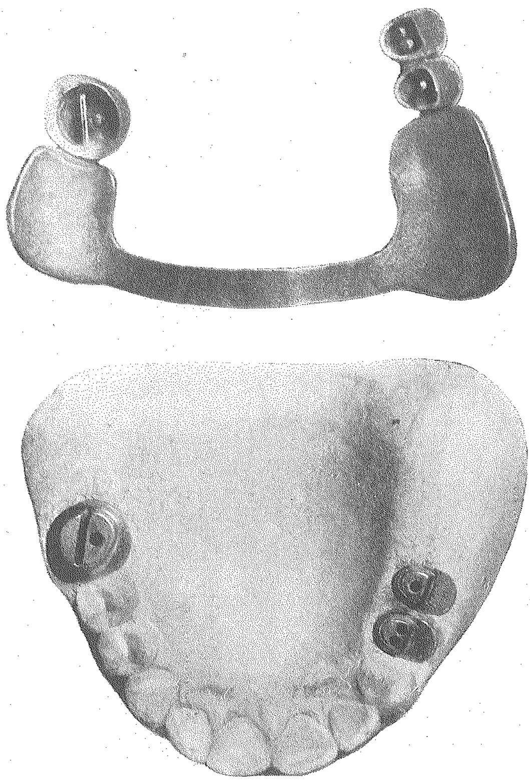


Fig. 643

Fig. 643 is a case often presenting itself especially in Rigg's disease mouths. Here the important feature is the palatal bar. The writer was, so far as he knows, the first to utilize these bars in bridge-work. After years of experiment, he finds the proper place for these bars to be very far back—usually near the junction of the soft and hard palate. There is no mechanical advantage in placing these forward (as is usually done) not possessed by those placed well back—and here they do not interfere with the tongue when properly constructed. Note how in mastication this bar overcomes leverage in three different directions, and it is at once apparent how very useful it would be where the alveolar process about the abutments was partially absorbed. This bar is made by flowing 20-carat solder on pure gold. The solder naturally assumes a rounded shape approximating a proper form next to the tongue. The *lower* bar is shaped *thick* at the bottom (to give it rigidity and so as to be rounded and *blunt* to the frenum), and thin at the top so as not to be noticed by the tongue. *Rigidity* is extremely important to overcome the leverage in both upper and lower bars. The first bicuspid in Fig. 643 shows two short tubes neither of which enter the canal. Room is left for the porcelain on the buccal side of the caps.

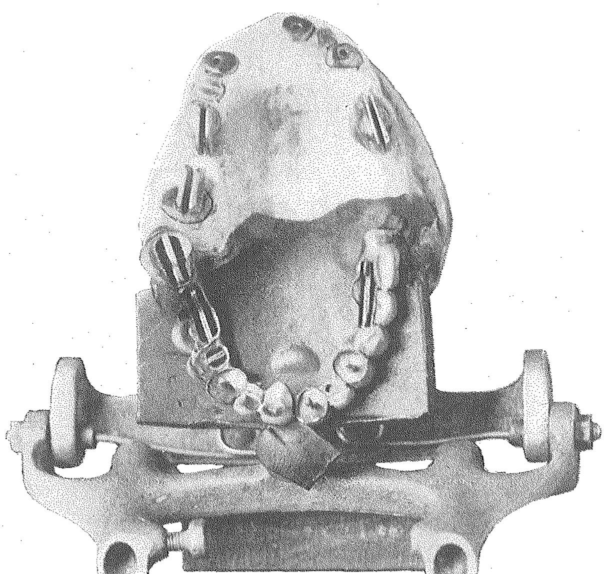


Fig. 644

Fig. 644 shows a case where all but seven teeth were lost from Rigg's disease. It will be noted that in this case (as in all the others) each abutment stands alone—no two are fastened together. In this way when the bridge is removed, a silk thread can be carried all around each abutment, beneath the gum; and this is important to prevent a return of peridental troubles. Each tooth also gets some individual motion in brushing and massaging.

The molar and bicuspid on the right show a modification of the same attachments shown in Figs. 642 and 643. These are longer and present more friction.

The bicuspid on the left shows another form of the split bar. It is not really a split bar, but two pieces of clasp metal soldered to a boxing at opposite ends. That is where one clasp metal bar is soldered, the other bar is a loose end. In other words, where in the other attachment the two pieces of clasp metal are soldered together at the same end of the boxing, these are soldered separately in the boxing at opposite ends. Each end of the boxing thus having one piece of clasp metal soldered to its wall.

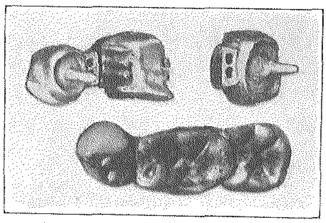


Fig. 645

Fig. 644 shows two small tubes swung off the side of a crown. These can be used where it is desirable to place the attachment on the side of a crown instead of within it. One tube is sometimes sufficient. This may be attached to inlays.

The dummy shows four split pins to fit the four tubes soldered to the two adjoining crowns.

The molar in Fig. 646 is the strongest of all attachments the writer has devised. Its chief application is in the upper arch where the bite is very short and where much of the bridge has to be supported by this single attachment. In this single crown it looks bulky but in a bridge this extension is incorporated into the dummy adjoining. Note the reinforcement of the clasp metal at the soldered ends to give it additional strength.

The bicuspid shows how this split bar may be used when the end of a bridge is on a bicuspid root that will not receive a tube. The cuspid shows attachment much like that of the left bicuspid in Fig. 644.

The bicuspid on the left side of Fig. 644 shows the attachment extending off both sides equally. Here was needed a large friction surface. This attachment differs from all the others in that instead of having the two pieces of clasp metal free at the same end, they are free at opposite ends. Thus where one is free, the other is soldered. This gives a more equal pressure all along—not as the other bars do or as a split-pin does.

The writer originated this form of attachment (the "split-bar") and has been demonstrating it at dental conventions in its various forms for about nine years. It is capable of a great variety of forms and applications. The original mechanical principle of this bar is the same as the split-pin as taught by Dr. Peeso.

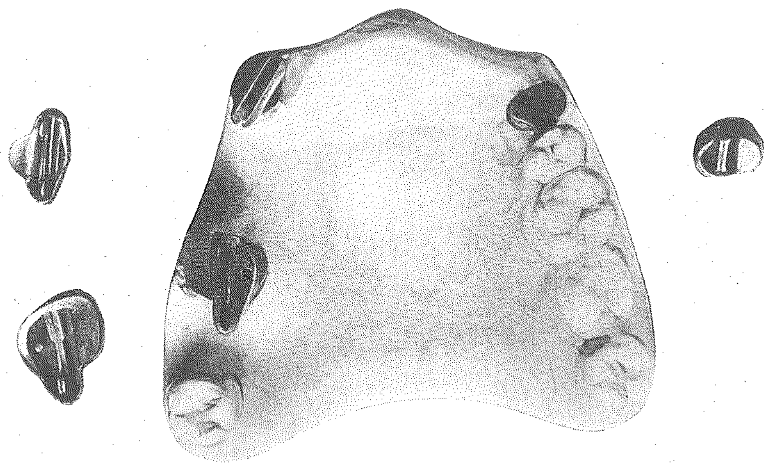


Fig. 646

This system in its present form was gradually evolved to be especially adapted to Rigg's disease conditions, but is, of course, equally applicable to any condition.

On studying these attachments closely one will see an astonishing amount of friction surface presented—the two pieces soldered to the cap being entirely boxed in beside the clasp metal running between. One end of the bar is, of course, free, allowing the two pieces to be spread just as the split pin is.

Space here forbids a detailed account of the construction of the various forms of these attachments, each of which must be adapted to the needs of the individual case.

CHAPTER XVIII.

DENTAL METALLURGY.[1]

Gold and its Alloys, Including Refractory Materials and Fluxes.

By Louis J. Weinstein.

In the preparation of this contribution, it has been the aim of the author to present a brief and practical, rather than an academic discussion of the subject.

In addition to a consideration of the gold alloys, it was found advisable to include a section on the closely-allied and important subjects of refractory materials and fluxes used in connection with gold, during soldering or casting operations.

The series of investigations, upon which this contribution is based, was started during the year 1908, when in attempting to use the coin gold and modifications of same in the form of solders, he was seriously handicapped by the comparatively low melting point of the coin gold, and the inadequacy of the other gold alloys usually obtainable, which, to the man of exceptional ability, is not so apparent as to one of average, or even less than average skill.

In view of the well-known fact that platinum is a metal that could be alloyed with gold to increase the melting point of the latter, a number of experiments were made to produce a formula for a gold alloy sufficiently high in melting point, so that the general practitioner could use it as a substitute for coin gold, and thereby eliminate the process of "sweating," and instead, solder the resultant high-fusing gold with other gold of a melting point equal to that of 24- or 22-K. and thus obtain a strong union that would withstand the subsequent, and often numerous, soldering operations required for the completion of the case.

The alloys finally developed were found so satisfactory, that it is not too much to say that even in the hands of the skilled operator these alloys will prove of considerable value, if for no other reason than the very great difference in the melting point between the highest and lowest fusing alloys in the series, and the consequent increased facility and safety during the necessary subsequent soldering operations.

In the author's efforts to obtain information from which to formulate alloys, he was greatly handicapped, inasmuch as there were no dental publications bearing to any extent on the subject. After a thorough study of the then recently revised books on dental metallurgy, a number of experiments were made, the results of which did not appear to correspond with the data in the text-books. A number of works on general metallurgy were consulted, and found to differ materially with the dental text-books in a great many instances, particularly on data concerning the behavior of the binary alloys of gold and silver, gold and platinum, etc. In order to establish a definite foundation upon which to base further researches, the author proceeded to make a series of binary alloys, and from the resultant data was enabled to proceed with the development of more complex alloys.

The resultant formulæ given herein have been in practical use for a period ranging from three to six years, and while the author does not claim that his is by any means the last word on the subject, he trusts that the results of his research will prove of some immediate benefit to both advanced students and practitioners.

The author takes this opportunity of thanking Drs. Edwin W. Harlan, Frederic A. Peeso, James H. Prothero, William S. Prensky, Mr. Harry C. Ney and other friends for their kind encouragement and aid.

TABLE No. I.—THE MELTING POINTS[1] AND DENSITIES OF METALS.

	Name of metal.	Symbol.	Melting point, ° F.	Melting point, ° C.	Density.
	GOLD	Au	1945	1063	19.3
Group I.—	Silver	Ag	1761	960	10.5
	Copper	Cu	1981	1083	8.9
	Platinum	Pt	3190	1755	21.5
	Palladium	Pd	2820	1550	11.4
Group II.—	Iridium	Ir	4170	2300	22.5
	Osmium	Os	4900	2700	22.5
	Rhodium	Rh	3525	1940	12.1
Group III.—	Zinc	Zn	787	420	7.1
	Cadmium	Cd	610	321	8.6
	Tin	Sn	450	232	7.3
	Aluminum	Al	1218	658	2.7
Group IV.—	Nickel	Ni	2646	1452	8.9
	Cobalt	Co	2714	1490	8.7
	Manganese	Mn	2237	1225	7.4
	Chromium	Cr	2750	1510	6.9
	Tantalum	Ta	5160	2850	14.5
	Tungsten	W	5430	3000	18.7
	Molybdenum	Mo	4500	2500	8.6
	Vanadium	V	3150	1730	6.1
	Titanium	Ti	3450	1900	4.5

The elements following gold have been divided into four groups. This division is an arbitrary one, and made solely for the purpose of facilitating future references.

[1] The melting points are according to the latest data published by the U. S. Bureau Standards.

BINARY ALLOYS.

It is a well-known fact that pure gold has but a limited use in the construction of various dental appliances, and that it is necessary to alloy it with various other metals, in order to increase its durability, hardness, and tenacity, and to vary the melting point above or below that of pure gold, as may be required. The metals in common use for this purpose have been copper, silver, and platinum, the latter to a limited extent, also zinc, cadmium, etc., for solders, which, of course, require a considerably lower melting point than the gold upon which they are to be used.

A thorough knowledge of the properties of the simple binary alloys is of paramount importance, because these properties almost invariably give an indication of what may be expected from more complex alloys.

It is generally accepted by metallurgists that binary alloys of gold and silver, copper, platinum, or palladium, form solid solutions, that is, solutions of one metal in another, if in proportions within certain limits. Such binary alloys as will be discussed, form solid homogeneous solutions, except when otherwise noted.

It is unnecessary to enter into an academic discussion of the possible molecular affinity existing among various elements or of eutectics, formed between the metals in the binary alloys that will be considered, because such compounds or mixtures do not occur in such alloys as may be considered fit for use in the mouth. For example, alloys of gold and copper in the proportion of 82 per cent. gold to 18 per cent. copper form a eutectic which is the lowest fusing of the gold copper series, and when more than 18 per cent. copper is present, the copper is not in uniform solution and segregates. As the alloys containing over 15 per cent. copper are extremely brittle and ununiform, no binary alloys containing more than 10 to 12 per cent. copper will be considered. In other words, alloys of gold and copper, where copper does not exceed 12 or 13 per cent., do not form any compounds with special characteristics.

To simplify the references to ternary, quaternary, or more complex combinations of metals, alloys of two metals will be termed, as is customary, "binary," but the alloys composed of three or more metals will be termed "complex" alloys.

Gold and Silver.—Silver is commonly utilized as an alloying element with gold. It is used, to a considerable extent, as part of the alloy in dental golds, and, as will be shown later, principally as a cheapening agent.

There seems to prevail generally an erroneous opinion regarding the properties of silver-gold alloys. It has been stated[1] that silver is used to harden and lower the melting point of gold. This deduction is distinctly contrary to the results obtained by the author. After making a number of binary alloys, it was proved that even the maximum percentage that may be used in dental work, say 25 per cent. of silver to 75 per cent. of gold, does not confer any perceptible hardness upon the gold, neither does it lower the melting point to such an extent that the difference could be measured with a pyrometer.

Practically the only effect silver (even if present to the extent of 25 per cent.) has upon gold, is to discolor the gold, making it greenish, and lower the specific gravity, thus increasing the volume. It will thus be seen that silver confers no special benefit upon gold, except cheapening it and acting as a color modifying agent. On the other hand, it may prove detrimental, as a considerable proportion of *silver may interfere with the action of other alloying elements* when attempting to produce a complex gold alloy, and also on account of the strong affinity that oxygen and other gases possess for silver. It will thus be readily seen that small percentages may sometimes be used to advantage as a color-modifying agent, but a large percentage of silver is distinctly contraindicated.

Silver, in such proportions as may be needed for dental golds, alloys uniformly and without difficulty, and may be depended upon to remain in uniform distribution.

The author has found that gold alloys, with a high percentage of silver, when remelted and cast, show in the casting a considerable variation of the silver content which indicates that a partial separation takes place. This has not been investigated further for the reason, that castings of gold with a high percentage of silver have no practical application. As stated before, small percentages of silver have practically no effect upon the gold and this fact has been taken advantage of, for a considerable period of time, by at least one manufacturer, who alloys pure gold with from 1 to 2 per cent. of silver, and sells it as 24-K. This alloy appears so similar to pure gold that the ordinary eye is deceived and the unprincipled manufacturer is the gainer.

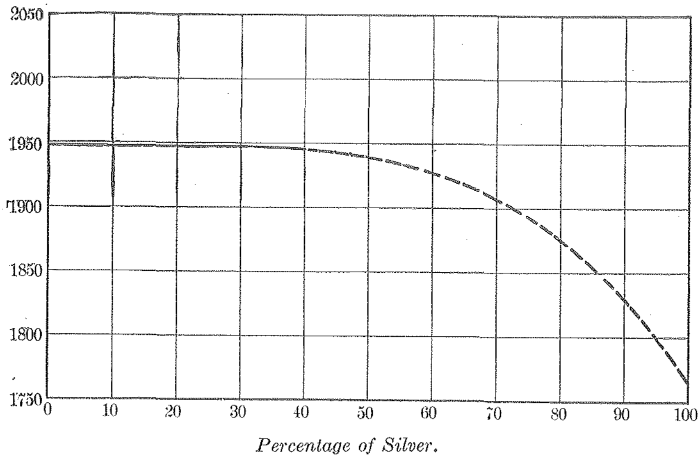
[1] Essig's Metallurgy (Koenig's revision), p. 163; Hodgen's Metallurgy (Milberry's revision), p. 278.

Fig. 647 illustrates the melting point curve of gold silver alloys.

Practically the same determination appears in very recent works on metallurgy.[1]

Silver-platinum alloys have been used, to a considerable extent, for crown posts, dowels, backings, etc. As a rule, alloys of this character (20 to 30 per cent. Pt.) are extremely unsatisfactory, both during their manipulation, and in ultimate service, and their use should be avoided. They are somewhat improved with higher

FIG. 647.—MELTING POINTS OF ALLOYS OF GOLD AND SILVER.



5	per cent.	Ag,	melting	point	1945° F., 1063° C.
10	"	Ag,	"	"	1945° F., 1063° C.
15	"	Ag,	"	"	1943° F., 1062° C.
30	"	Ag,	"	"	1942° F., 1061° C.

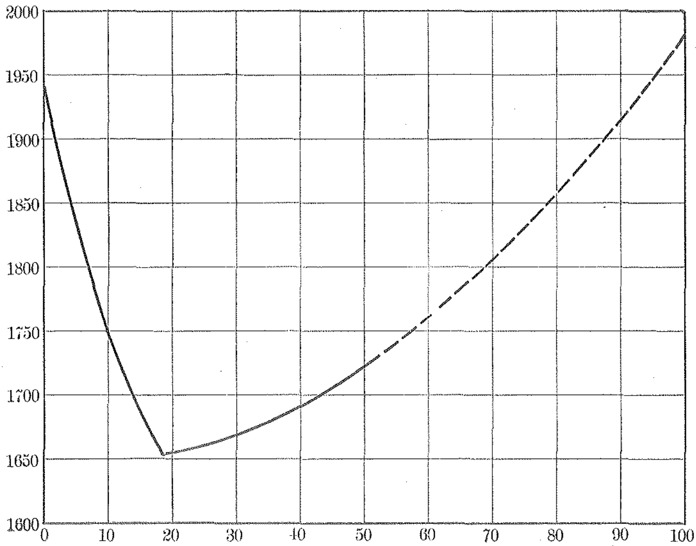
percentages of platinum or palladium, but the alloys are extremely ununiform and still quite soluble in acids and apt to discolor and corrode. The cost with more platinum is considerably higher and even then the alloys are not equal to a fair grade of alloyed gold, either in usefulness, or economy.

Gold and Copper.—Copper is one of the most commonly used and most useful alloying elements. It confers hardness and elasticity upon gold, but is detrimental when used in large proportions, on account of its great tendency to lower the melting point of the alloy, and the strong oxidation and brittleness of the alloys. The copper is in high proportion. It is, however, a most useful,

[1] Fenchel's Metallurgy.

and in fact an *indispensable* alloying element, if employed judiciously. Alloys of gold and copper, such as U. S. coin gold (Au. 90- Cu 10), have been used with most satisfactory results both from the standpoint of durability and resistance against the oral fluids. An alloy of this character is ideal for crown work, except for the disadvantage of its low melting point, which is caused by the copper content and its range of usefulness is therefore limited,

FIG. 648.—MELTING POINTS OF ALLOYS OF GOLD AND COPPER.



5 per cent.	Cu,	melting point	1840° F.,	1004° C.
10 "	Cu,	" "	1735° F.,	946° C.
15 "	Cu,	" "	1690° F.,	921° C.
18 "	Cu,	" "	1661° F.,	905° C.

even in the hands of the skilled operator. This inadequacy, as will be shown later, can be corrected by substituting platinum, etc., for some of the copper, thus raising the melting point, and reducing oxidation, without changing the valuable properties the coin gold possesses; namely, strength and durability.

Fig. 648 illustrates the melting point curve of gold-copper alloys. As will be seen from the chart, the melting point of pure gold drops rapidly upon the addition of copper; 5 per cent. copper lowers the melting point about 100° F.; 10 per cent. copper lowers the melting point of gold about 200° F.; 15 per cent. copper lowers the melting point about 250° F.; and 18 per cent. causes a drop in melting point of about 300° F. As will be seen from the illustration, the lowest melting point between gold and copper is when 18 per cent. cu. is present. The addition of more than 18 per cent. cu. causes a rise in melting point until the melting point of copper, 1980° F. is reached.

As mentioned previously, it is advisable to limit the total copper content to 10 or 12 per cent. Consequently, if the melting point of an alloy of gold and copper of requisite strength and hardness is too low, it is necessary to use platinum or palladium to bring it to the point desired.

The valuable properties of copper as a hardening agent have apparently been underestimated, and not given sufficient consideration by writers, but taken advantage of by manufacturers, as will be noted in the composition of commercial clasp metals.

Gold and Platinum.—Platinum is being used to some extent as an alloying element with gold, principally for clasp metal, etc. It has been stated that platinum confers great elasticity and hardness upon gold, which appears correct only to a limited extent. The author's experiments have indicated that platinum has comparatively little effect as a hardening agent upon gold. It does, however, raise the melting point considerably, as will be shown later.

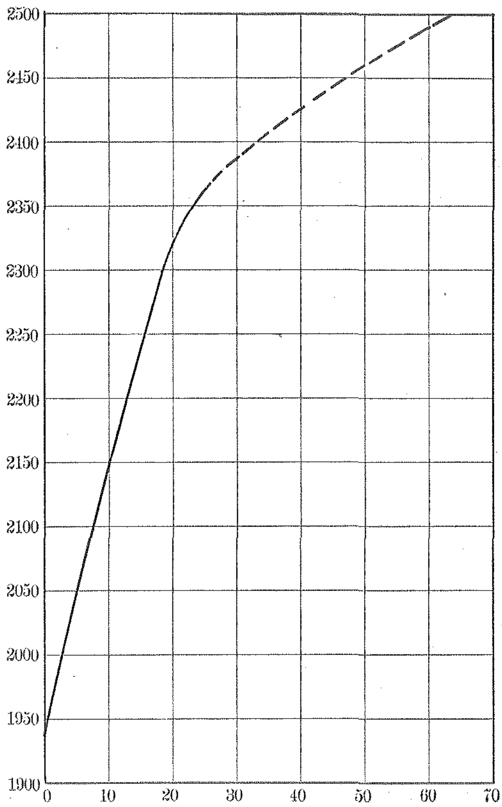
Platinum is much inferior to copper as a hardening agent. This is readily proven upon an examination of a binary alloy of gold and copper containing 10 per cent. copper, and a binary alloy of gold and platinum containing 25 per cent. platinum (so-called platinum solder). A comparison of two pieces of equal dimension will show that the gold-copper alloy, with 10 per cent. copper is quite as hard and elastic as the gold alloy with 25 per cent. platinum, and more uniform. It is therefore evident that platinum is not the most suitable hardening agent, and its range of usefulness as an alloying element is therefore limited.

Platinum, however, is an excellent adjunct to copper, as it tends to raise the melting point, which is lowered sensibly by any considerable percentage of copper.

Fig. 649 illustrates the melting point curve of gold-platinum alloys.

Large percentages of platinum cannot be alloyed uniformly with gold, and in order to insure a uniform alloy, it is not advisable to use more than 5 to 10 per cent. in a binary alloy and 10 to 15 per cent. in a complex alloy. In the latter, the *other alloying elements help to hold the platinum in uniform distribution.* If it is desired to raise the melting point of an au.-cu. alloy higher than 5 to 10

FIG. 649.—MELTING POINTS OF ALLOYS OF GOLD AND PLATINUM.

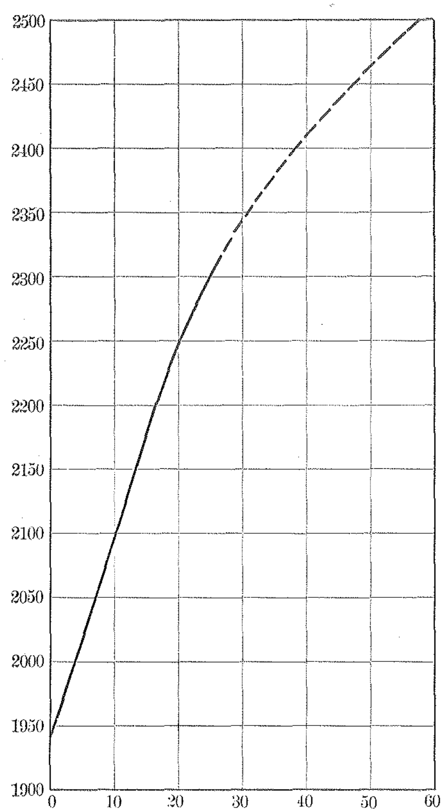


5 per cent.	Pt,	melting point		2015° F., 1102° C.
10	"	Pt,	" "	2080° F., 1141° C.
15	"	Pt,	" "	2165° F., 1165° C.
20	"	Pt,	" "	2260° F., 1228° C.

per cent. platinum makes possible, it is advisable to use *palladium,* which *combines perfectly* in both the binary and complex alloys that will be considered.

Gold and Palladium.—Palladium is as yet a comparatively rare metal. It has been used to some extent in the industries and arts, but practically to no extent in dental golds. Palladium is a metal very similar to platinum except for its specific gravity, 11.4, which

FIG. 650.—MELTING POINTS OF ALLOYS OF GOLD AND PALLADIUM.



Percentage of Palladium.

5 per cent.	Pd,	melting	point	2060° F.,	1127° C.
10 "	Pd,	"	"	2145° F.,	1174° C.
15 "	Pd,	"	"	2250° F.,	1232° C.
20 "	Pd,	"	"	2340° F.,	1282° C.

is considerably lower than platinum, and its melting point, which is also considerably lower than that of platinum.

It has been stated that palladium makes gold brittle. This is contrary to the author's findings. More than twenty-five different alloys were made containing from 1 to 30 per cent. palladium. All of them appeared quite uniform and remarkably malleable, ductile and tenacious.

Palladium also forms excellent uniform alloys with copper, silver, etc., and it is a very valuable adjunct to platinum in complex gold alloys. Its use, however, is limited, on account of the fact that it exerts a strong decolorizing action upon gold, 3 to 5 per cent. turning gold sensibly lighter, and 15 to 20 per cent. almost white (platinum color).

Fig. 650 illustrates the melting point curve of gold-palladium alloys.

Another remarkable and most valuable property that palladium possesses, is the fact that although the melting point, 2820° F. (1550° C.), is considerably lower than that of platinum, a given percentage of palladium (by weight) will increase the melting point of gold more than an equal amount of platinum, and in view of the fact that platinum in considerable percentages does not alloy uniformly with gold, it is well to use palladium, as it alloys uniformly with gold in all proportions. Therefore in alloys where color is no object palladium may be incorporated to very great advantage.

TABLE II.—MELTING POINTS OF BINARY ALLOYS.

GOLD—SILVER.

Melting point of	gold			1945° F., 1063° C.
" "	silver			1761° F., 960° C.
" "	gold, 95 per cent.,	silver, 5 per cent.		1945° F., 1063° C.
" "	gold, 90 "	silver, 10 "		1945° F., 1063° C.
" "	gold, 85 "	silver, 15 "		1943° F., 1062° C.
" "	gold, 70 "	silver, 30 "		1942° F., 1061° C.

GOLD—COPPER.

Melting point of	gold			1945° F., 1063° C.
" "	copper			1980° F., 1083° C.
" "	gold, 95 per cent.,	copper, 5 per cent.		1840° F., 1004° C.
" "	gold, 90 "	copper, 10 "		1735° F., 946° C.
" "	gold, 85 "	copper, 15 "		1690° F., 921° C.
" "	gold, 82 "	copper, 18 "		1661° F., 905° C.

GOLD—PLATINUM.

Melting point of	gold			1945° F., 1063° C.
" "	platinum			3190° F., 1755° C.
" "	gold, 95 per cent.,	platinum, 5 per cent.		2015° F., 1102° C.
" "	gold, 90 "	platinum, 10 "		2085° F., 1141° C.
" "	gold, 85 "	platinum, 15 "		2165° F., 1165° C.
" "	gold, 80 "	platinum, 20 "		2260° F., 1228° C.

GOLD—PALLADIUM.

Melting point of	gold			1945° F., 1063° C.
" "	palladium			2820° F., 1550° C.
" "	gold, 95 per cent.,	palladium, 5 per cent.		2060° F., 1127° C.
" "	gold, 90 "	palladium, 10 "		2145° F., 1174° C.
" "	gold, 85 "	palladium, 15 "		2250° F., 1232° C.
" "	gold, 80 "	palladium, 20 "		2340° F., 1282° C.

Gold and Metals in Group 2.—Iridium.—Iridio-platinum is usually employed in place of pure platinum on account of its greater hardness and durability. When experimenting with the series of binary alloys previously discussed, it naturally suggested itself to the author, that gold alloyed with iridio-platinum, instead of pure platinum, would prove superior. A number of alloys were attempted and the results obtained were found invariably inferior to alloys of gold and pure platinum. The unsatisfactory results should have been anticipated because it is well known that iridium will not alloy with gold uniformly, but segregates on account of its extremely high melting point and high specific gravity. It is quite certain that in attempting to make the alloy, the following occurred: When the iridio-platinum was brought into the gold, the heat used was sufficient to melt the platinum and set free the particles of iridium which did not go into solution with the gold platinum mixture, but suspended, and then segregated practically in the same way as if free iridium were added to gold without the presence of the platinum.

The experimental alloys were made of pure gold and 15 per cent. iridio-platinum, and compared with alloys made of pure gold and 15 per cent. platinum. On rolling both to equal gauge, polishing and etching, the gold-platinum alloy was found quite uniform, whereas some sections of the gold iridio-platinum alloy were harder and higher fusing, while other sections were softer and lower fusing than the gold-platinum alloy. In addition, all the gold-platinum-iridium mixtures appeared streaky and ununiform, even to the naked eye, while the gold-platinum alloys appeared almost perfect even under the microscope.

Numerous other experiments were made, along these lines, and in spite of the fact that some have advocated the use of iridio-platinum instead of pure platinum in alloys, it is the author's conclusion that pure platinum is far superior to iridio-platinum as an alloying element with gold.

Osmium.—No attempts have yet been made to form alloys with osmium, as it is even higher fusing than iridium and therefore poor results may be anticipated. The author expects, however, to experiment with osmium shortly, to determine if there is any possible benefit to be derived from it, because alloys of Os–Pt are claimed to be superior to alloys of Ir–Pt.[1]

[1] F. Zimmerman, Alloy of Platinum and Osmium, U. S. Patent No. 1055, 119, 24.

Rhodium.—Rhodium is another metal of the platinum group that will prove of considerable benefit if sufficient of it could be obtained at a moderate cost. It is quite similar to palladium. It also has a low specific gravity, 12.1, and is considerably higher fusing than platinum (according to U. S. Bureau of Standards).

The author has not experimented with it in the pure state, but procured a quantity of it in the form of platinum containing 10 per cent. rhodium. This platinum-rhodium alloy was used for a considerable time instead of pure platinum. The alloys were quite satisfactory, but the advantages over pure platinum as an alloying agent are so slight, and the cost so high, that it appeared advisable to discontinue its use at the time.

Gold and Metals in Group 3.—(See under Gold Solders.)

Gold and Metals in Group 4.—Sometime after the introduction of the casting process, it became apparent that in order to utilize the casting process to advantage, alloys other than ordinarily obtainable would have to be made in order to insure satisfactory results. The ordinary plate golds obtainable, when cast in small bulk, were too soft and frail, and the sections had to be cast larger and heavier than normal, and were therefore objectionable.

A number of experiments were made in attempting to cast the various clasp metals, and the results obtained were very unsatisfactory. At this time began to appear literature regarding industrial alloys both ferrous and non-ferrous, with the so-called rare, or little known, metals, such as nickel, cobalt, manganese, tungsten, vanadium, etc., enumerated in the table of elements under Group 4.

Some remarkable results were obtained in various industrial steels, brasses, and bronzes, and it was not unreasonable to expect that some of these rare metals could be utilized to advantage in the formation of gold alloys for casting purposes.

In view of the fact that there was no precedent to follow and no literature obtainable on the relation of these metals to gold, it can readily be understood that the author's attempts to alloy these rare metals with gold were more or less empirical, and the results obtained were no better than should have been anticipated. Meeting with such poor success, the author proceeded with the series of researches into both the binary and complex alloys of gold with the elements in groups one, two and three and the resultant formulæ developed are given herein in the following pages.

Since then, a number of experiments have been made by other investigators, in attempting to utilize some of the rare metals such as nickel, tungsten, molybdenum, titanium, etc., as substitutes for iridio-platinum. The results so far have not proved successful.

This non-success will not appear strange to those familiar with both the chemical and physical characteristics of the elements mentioned. Unless some radical method of handling these metals is evolved iridio-platinum will continue to retain the position it occupies (see elastic gold under clasp metals).

The author has not by any means given up hope of the possible utilization of some of the rare elements in connection with alloys for casting. He is now engaged in a series of experiments which have already shown promising results and he hopes to have data of importance available for publication in the near future.

A NEW SERIES OF ALLOYS.

From the preceding data on the properties of the binary alloys of gold with the metals in Group 1, certain conclusions may be drawn and data obtained, and it then becomes a comparatively simple matter to form complex alloys for our requirements. Before proceeding to formulate a complex alloy, it will be well to consider again the hardness conferred upon gold by the metals in Group 1.

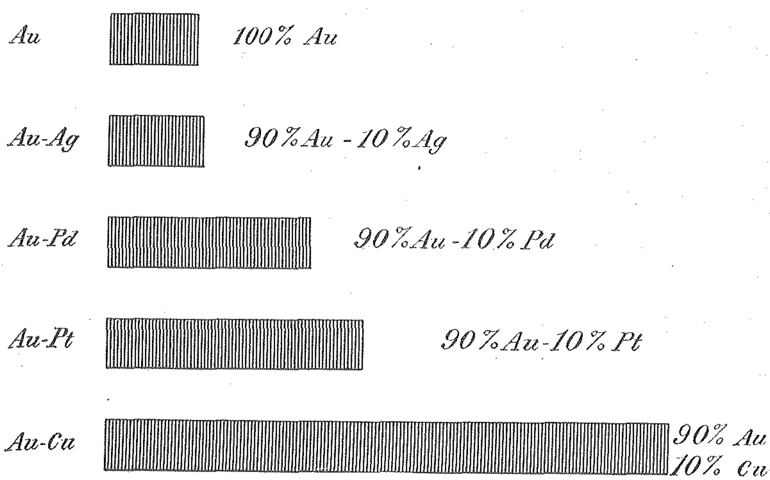


FIG. 651.—Comparative hardness of binary alloys.

As will be seen from Fig. 651, pure silver has practically no effect on gold as far as increasing its hardness. Palladium has some hardening properties, and it is well to bear that in mind when formulating an alloy. Platinum has considerably more hardening power than palladium and is a factor, but copper is the most valuable agent of them all, and in proceeding to formulate the complex alloys, we must consider the copper as the principal hardening agent and the others as adjuncts.

Gold for Crown, Bridge and Plate Work.—Gold Plate No. 1.—Bearing in mind the hardening power, and the effect on melting point produced by the alloying elements, let us consider such a formula as the following:

FORMULA OF GOLD PLATE No. 1.

	Per cent.
Gold	88.0
Platinum	7.5
Palladium	2.5
Silver	2.0
Total	100.0

MELTING POINT 2075° F., 1135° C.

This alloy is equivalent in hardness to ordinary 22-K. gold, containing 91.6 per cent. gold, 3.5 to 4 per cent. copper and 4.5 to 5 per cent. silver. Now, as the copper is the active hardening agent in the 22-K. gold and as we know from the preceding data that platinum and palladium exert somewhat less than half of the hardening influence of copper, it will be seen that the total of 10 parts platinum and palladium are about equal in hardening power to the 3.5 to 4 parts of copper usually present in 22-K. gold; and thus we get an alloy equivalent in hardness to the ordinary 22-K. plate.

The silver content, 2 parts, is no factor whatever, except as a color-modifying agent, because it is an object to adhere to a certain standard of color throughout the whole series of alloys. As there is no copper whatever present in this alloy, it is absolutely non-oxidizable, but the great advantage that an alloy of this character possesses over an ordinary 22-K. plate is the fact that its melting point is much above that of ordinary 22-K. gold, approximately 225° F to 250° F. higher, and instead of sweating a band and floor, it may be very easily soldered with pure gold or 22-K. plate and resoldered with the same or lower-grade plate gold innumerable times, without any danger of burning or blistering.

Any, or all, of the alloys in the series following plate No. 2, may be safely used as solders on plate No. 1, thus permitting many soldering operations *without danger of burning the gold*, as may occur in sweating, or the danger of the solder (if poor quality) burning into and alloying with the gold, as often occurs when using the so-called "easy-flowing" solders. It is evident, therefore, that this alloy offers a great many advantages over the ordinary 22-K. plate gold.

Gold Plate No. 2.—As has been impressed by Dr. Peeso, it is absolutely essential to use for removable bridge-work, a hard, durable gold, such as U. S. coin gold. It may be well, at this time, to state that U. S. coin gold contains 90 per cent. pure gold and 10 per cent. copper, whereas the so-called coin gold obtainable from most supply houses contains, as a rule, some silver, which softens it and makes it *work more easily*, it therefore does not possess the strength and durability required.

The following formula replaces coin gold most satisfactorily:

FORMULA OF GOLD PLATE No. 2.

	Per cent.
Gold	84.5
Platinum	8.5
Palladium	2.0
Silver	0.5
Copper	4.5
Total	100.0

MELTING POINT 1975° F., 1080° C.

In this formula, in order to obtain the equivalent hardness of coin gold, it is necessary to use copper. We can again readily see just how the hardening properties of the alloying elements are utilized. We have 4.5 per cent. copper, and the platinum and palladium replace the rest of the copper, thus giving us an alloy equal to U. S. coin gold. This oxidizes, of course, to a slight extent, but the oxidation is not objectionable, and this alloy can be used to replace coin gold practically for every purpose, and may be soldered with other alloys in the series which have the same color. When soldered with casting gold, B or C, the attachment of the floor to a band cannot open up during the final soldering unless deliberately abused, because the soldered junctions are actually higher in melting point than ordinary gold plate.

The fusing point of this alloy is approximately 225° F. higher than coin gold, and it possesses all the advantages over coin that the No. 1 formula has over 22-K. gold.

These alloys, Nos. 1 and 2, can be utilized to great advantage in the construction of swaged plates, both full and partial, especially where it is desired to make the plates of two or three thin layers, on account of the high melting point of the alloys, which permits of thorough soldering of the laminæ without danger of burning. When used in conjunction with the other alloys in the series, these golds enable the operator to produce dentures far superior to those made from the golds ordinarily employed, on account of increased strength, minimized bulk, and perfect color harmony, throughout the whole structure.

It should be borne in mind that high fusing golds, such as these, cannot be "sweated" advantageously. This is a characteristic of all gold alloys high in platinum metals.

Alloys for Prosthetic Castings.—As has been previously stated, in order to cast sections of bridge-work, saddles, partial plates, etc., it is essential to have alloys that are rigid in the cast form, to obviate the necessity for increased bulk. Again, the value of the hardening properties of the alloying elements becomes apparent, as in the following:

FORMULA OF CASTING GOLD "B."

	Per cent.
Gold	80.0
Platinum	9.5
Palladium	2.5
Silver	1.0
Copper	7.0
Total	100.0

MELTING POINT 1975° F., 1080° C.

We have here 7 per cent. copper and a total of 12 per cent. of the platinum metals, which makes an alloy considerably harder than coin gold. When cast, this alloy is about midway in hardness between rolled coin gold and clasp metal. The melting point of this alloy is about 50° F. below pure gold. It is intended for use with the nitrous oxide blow-pipe and should be melted with same, if a considerable quantity of gold is to be cast. Sufficient quantities for small castings can be melted with the ordinary blow-pipe. The copper content being comparatively low permits of the use of the nitrous-oxide blow-pipe without any material change or deterioration of the alloy, if a suitable reducing flux is used in connection with it.

This alloy corresponds in color with plate No. 1 or No. 2, and may be used to cast cusps or cusps and contours directly to bands of either plate No. 1 or plate No. 2. It makes a particularly suitable gold for cast occlusal surfaces on account of its hardness and durability.

The next formula is a modification of "B" and brings out an interesting point in connection with the effect of copper and the platinum metals on the decrease and increase of melting points.

FORMULA OF CASTING GOLD "C."

	Per cent.
Gold	80.5
Platinum	6.5
Palladium	2.0
Silver	2.0
Copper	9.0
Total	100.0

MELTING POINT 1800° F., 980° C.

We note in this formula an increase of two parts of copper and a decrease of a total of 3.5 parts platinum and palladium, the consequence being that the melting point is dropped by the increase of copper and by the decrease of the platinum metals. The melting point is dropped about 100° F. and brought down to approximately that of 22-K. gold. This lowering of the melting point permits this alloy to be melted readily for large or small casting with an efficient illuminating gas and air blow-pipe. It is identical in strength, hardness, color, etc., with casting gold "B" except the fusing point and resistance to the nitrous oxide blow-pipe flame. If the latter is used, caution must be taken to use a reducing flux and not superheat the metal. This applies to coin gold, too, if same is cast. *Excessive heat, if applied with the nitrous oxide blow-pipe, and lack of a suitable reducing flux, will permit the oxidation of considerable copper and the dissemination of oxide throughout the casting.*

Gold for Inlay Casting.—Since the introduction of the casting process, pure gold has been generally advocated for cast fillings, etc., on account of its supposed minimum shrinkage, softness and malleability, and consequent ease with which the margins could be burnished to eliminate the cement line of an inlay.

A good many operators have failed to cast pure gold satisfactorily and claim that they can cast inlays with scrap gold and produce better and sharper margins. To those who have not experienced this difficulty, it may appear very strange, but, nevertheless, it is a fact that alloyed gold, when properly alloyed, and under fair-casting conditions, invariably casts with sharp, true margins, whereas pure gold has very often failed to accomplish the purpose, both at the hands of the author and many others.

It may be well to consider that the casting of scrap gold of indefinite composition is rather a hazardous and usually unsatisfactory procedure and a great many operators recognizing that fact, are using 22-K. gold, coin gold, etc., with better results than they have been able to obtain with pure gold.

It is a well-known fact that pure platinum, pure palladium and pure silver absorb hydrogen, oxygen and other gases, while in the molten state, and retain some of the gases upon solidification. It is not generally known, but nevertheless true, that pure gold absorbs nitrogen, hydrogen and oxygen, and retains a considerable percentage of one or more of the absorbed gases upon solidification.[1] This tendency, on the part of the metals mentioned, to absorb gases, is minimized and sometimes entirely eliminated by alloying and a small percentage of copper, palladium or platinum will materially alter the behavior of pure gold upon solidification. Castings made with a slightly-alloyed, pure gold, will be found to possess sharp margins and practically equal pure gold in color, ductility, and facility of burnishing, and to be comparatively free from cavities or blow-holes, such as are often found in unalloyed gold castings.

A number of cases under observation have shown that fillings of slightly-alloyed gold do not, after a period of wear, present the same pitted surface so characteristic of cast pure gold fillings under the same conditions.

The rounding of the margins in cast pure gold fillings is usually accompanied by a separation of the residue button from the casting which takes place just prior to the completion of solidification. This occurs particularly when a comparatively large sprue is used, and more especially when a large residue button is used at the same time. An explanation of this occurrence may reasonably be attributed to the following: If the sprue is quite large, and the gold residue button large, the residue remains fluid for a considerable period of time after the casting pressure has been applied, and there appears to be a tendency for the large button to draw to it the gold of the casting through the medium of the large gate (the sprue). A large button of gold very often draws only part of the sprue to it, thus separating the connection between the residue button and the casting, and arresting the exercise of the casting pressure which would otherwise be transmitted from the button to the sprue and then to the casting proper. For those who wish to use pure gold for casting, it is suggested that the quantity of gold used

[1] Roberts-Austen, Introduction to the Study of Metallurgy.

in the casting operation should not exceed more than three pennyweights above the amount actually required for the casting proper, and also that the sprue be no larger than 16 gauge B. and S. This will serve to lessen the area of connection between the casting and residue button, so that this area (the sprue) may solidify more rapidly, and in conjunction with the smaller button, which naturally freezes more rapidly, tend to prevent the separation previously discussed.

Another point that is well to consider, is the fact that alloying of gold reduces the surface tension and cohesion of the molecules while in a molten state, and increases the fluidity, thus facilitating the flow of the metal, requiring less pressure to force the gold into the mould, and consequently, lessening the danger *of distorting the mould.* (See investment compounds for casting.)

FORMULA OF CASTING GOLD "A."

	Per cent.
Gold	97.0
Platinum	1.5
Palladium	0.3
Silver	0.3
Copper	0.9
Total	100.0

MELTING POINT 1945° F., 1063° C.

This alloy makes an efficient substitute for pure gold, as the comparatively small amount of alloy does not harden the gold sufficiently to prevent burnishing, nor does it affect the color perceptibly. Copper is the most suitable agent for increasing the fluidity, and the small percentage used does not materially harden the gold. The drop in melting point is compensated for by the platinum, and the small percentage of silver counteracts the coloring effect of the copper on the gold, the consequent alloy possessing practically the same melting point as pure gold, and producing, almost invariably, *sound castings, without the special precaution* which must be taken when pure gold is used.

This alloy will be found suitable for use in teeth close to others, with fillings or inlays made of pure gold, in order to maintain color harmony.

As all the alloys in the series, excepting the casting gold A and the elastic alloy described later, are practically of a uniform color and somewhat lighter (grayish red) and less conspicuous than pure gold or coin gold, it has been found advisable to also formulate an alloy for casting inlays to harmonize in color with the rest of the series.

FORMULA FOR CASTING GOLD "D."

	Per cent
Gold	95.0
Palladium	3.3
Silver	0.4
Copper	1.3
Total	100.0

MELTING POINT 1945° F., 1063° C.

In this alloy, the palladium decolorizes the pure gold, and raises the melting point. The copper brings it back to the pure gold standard, and by the addition of the small percentage of silver to counteract the reddening effect of the copper, a color effect is obtained in perfect harmony with the rest of the series.

This gold is quite soft and malleable and may be burnished with practically the same facility as pure gold. This question of burnishing margins of inlays is rather a more or less indefinite procedure. It is the author's opinion that very little effective burnishing (spinning) can be done on inlay margins, and that only after the margins are stoned down to an extremely thin edge. Experience has shown that it is advisable to use hard and durable alloys for inlays, especially those intended to aid in supporting bridge-work, and then only when supplemented with posts or dowels.

This alloy, D, can be combined with B or C, to obtain harder alloys, with no difficulty and no change in color, thus enabling the operator to obtain practically any degree of hardness for special requirements in inlay casting.

CLASP METALS.

As previously stated, the alloys known as clasp metal, or platinized gold, as ordinarily obtainable, have been used, with poor results, for casting sections of bridge-work, etc., and are being used to a large extent, and with but mediocre results, as a substitute for iridio-platinum for crown posts, dowels, etc. The ordinary clasp metal is also used to a considerable extent for posts or dowels in the construction of cast base crowns, with usually poor results, on account of its brittleness, especially after it has been cast against. There appear to be about four distinct types of clasp metal obtainable at the supply houses.

The following formulæ are nearly exact and type one and two readily indicate the particular rôle that copper plays as a hardening agent:

TABLE III.—COMPOSITION OF CLASP METALS.

CONSTITUENT METALS.	Type 1.*	Type 2.*	Type 3.*	Type 4.**	Elastic gold.
Gold	63	65	63	65	64.0
Silver	14	15	17	6	1.5
Copper	21	13	7	7	7.0
Platinum	2	7	13	18	11.0
Palladium . . .	..	..	..	4	16.5
Comparative Melting Point	1600° F. 870° C.	1725° F. 940° C.	1860° F. 1015° C.	1960° F. 1070° C.	2100° F. 1150° C.

* From analysis. ** Is known commercially as "high fusing" clasp metal.

Type 1 represents a class of clasp metals of which there are several on the market. They contain a trace of platinum, so that they may legally be called platinized gold, and a very high percentage of copper. The copper content confers a high degree of hardness and elasticity upon the alloy, but during subsequent heating (soldering and annealing) and working, the alloy softens considerably and loses a good deal of the original elasticity, and sometimes becomes very brittle, especially when over-heated.[1] As the melting point is quite low, soldering with even a comparatively low fusing solder is apt to endanger the integrity of the alloy more often than not.

Type 2 represents a class of clasp metals which contain a larger percentage of platinum and less copper. This alloy, while not quite as elastic before annealing, retains its elasticity after annealing or soldering, better than type one, and makes a quite satisfactory material for clasps for vulcanite work, etc., if not excessively heated and otherwise abused.

Neither of the two alloys are suitable for work requiring repeated soldering operations. Posts or dowels made of these alloys and cast against, usually show a partial fusion and although this fusion is not always evident, the posts if cast against break away (at the junction) ultimately. These alloys are absolutely unfit for the making of split pins.

Type 3 offers a much better material. It contains still less copper, and more platinum, but has not sufficient strength and elasticity. For want of a better material, it has been used for the

[1] Gold-silver-copper alloys containing over 15 per cent. copper are quite brittle, very ununiform, and variable in behavior upon annealing.

construction of split pins for a number of years. In addition, the fusing point, although higher than that of types one and two, is too low, and when attempting to solder the solid portion of a split pin with coin gold, the metal is apt to fuse partly, becoming granular and brittle, and the finished pin is apt to give out in use. The type three clasp metal has been cast against with fair results, but the danger of burning it is imminent.

In the three types of clasp metals under discussion is demonstrated the value of copper, and its superiority over platinum as a hardening agent, and the value of platinum, in raising the melting point lowered by the copper.

A number of experiments were made to improve the type three clasp metal, and it can readily be seen from formula of type four, how comparatively simple it was to do so, having established the properties of the binary alloys as a foundation. By raising the platinum to 18 points, the melting point and the elasticity were increased somewhat. Even at this stage, the advance in melting point appeared insufficient, and, as it was deemed advisable to avoid more platinum on account of the danger of its not alloying uniformly, palladium which alloys readily was added, and the melting point increased to a total of app. 100° F. above type three. No more palladium was used on account of its decolorizing action. With the comparatively small content (4 per cent.), the color of the alloy is still quite gold-like. This alloy has been used with uniformly good results. It may be soldered safely with coin gold (for split pins), and may be cast against safely if a comparatively heavy gauge of wire (above 16 g. B & S) is used.

In view of the fact that for split pins, dowels for cast base crowns, etc., color is no object, it was deemed advisable to raise the melting point even above that of type four and the elastic gold was formulated, using a considerable percentage of palladium. The palladium, of course, decolorized the alloy completely, but raised the melting point very considerably, and, in conjunction with the copper and the considerable percentage of platinum, produced an elasticity even beyond that of type four, and a melting point very considerably higher.

This alloy can be soldered with perfect safety with pure gold or anything below that in melting point. It may be cast against with perfect safety (except very thin wire), and retains its strength and elasticity after any reasonable number of soldering operations that it may necessarily be subjected to. *It may be soldered very* *readily and with better union than iridio-platinum. It is much more rigid than ordinary iridio-platinum, and possesses elasticity that is practically absent in all of the iridio-platinum alloys and it may therefore replace the latter and ordinary clasp metal for a great many purposes.*

In the making of split posts of the elastic gold, it is advisable to solder the area that is intended should remain solid with coin gold, as it offers a strong color contrast to the comparatively white elastic gold.

The line of demarkation between the solid and the split portions of the post, will be then readily distinguished. As the coin gold is of sufficiently high melting point, it will not reflow during later soldering operations.

The comparative hardness and the elasticity of the four types of clasp metals and the "elastic" gold is approximately as illustrated in the following:

COMPARATIVE ELASTICITY AFTER ROLLING AND ANNEALING ONCE.

Type 1.	Type 2.	Type 3.	Type 4.	"Elastic" Gold.
10	9	8	9+	10+

COMPARATIVE LOSS OF ELASTICITY AFTER SOLDERING AND ANNEALING THREE TIMES.

Type 1.	Type 2.	Type 3.	Type 4.	"Elastic" Gold.
2–3	1–2	1+	1	.5–1

Types one and two become very brittle if overheated during soldering. Type three is subject to same to a lesser degree and type four only occasionally. The "elastic" gold appears practically immune to temperatures below the melting point of pure gold.

Clasp metal should always be annealed before use, as manufacturers often neglect to do so after the rolling or drawing operations.

GOLD SOLDERS.

In order to obtain the desirable uniformity of color in a denture without subsequent gold "washing," as advocated by some, it was necessary to formulate solders to correspond in color with the other alloys. Incidentally, it is well to consider the imposition that has been practiced upon the profession by some of the unscrupulous manufacturers of gold solders.

For many years, a great many in the profession have been under the impression that gold solders stamped 18-K. were actually 18-K. (75 per cent. gold) in fineness. This was not so and a number of the manufacturers were producing, and are still producing, solders marked 18-K., etc., anywhere from two to six karats below the mark. In addition, the solders mentioned are not only deficient in gold content, but contain many deleterious alloying elements, such as high percentages of cadmium, iron, etc., in order to complete the required total content of base metals in the solders.

On the other hand, the reputable manufacturers have consistently stated that their solders were approximately two karats below the mark, and intended for use on that karat of plate. The reputable manufacturers have recently started to stamp the actual fineness on their solders and the others have followed suit; but some manufacturers still persist in the practice of misrepresentation by not actually furnishing the gold content indicated by the fineness stamp on the product.

Alloys of Gold with Metals in Group 3.—Besides zinc, the other three metals in Group 3, namely, cadmium, tin and aluminum, are being used to a very large extent as alloying elements in making gold solders. Cadmium, if used in large percentages, debases the alloy very considerably and renders it practically unfit for use in the mouth.

Tin is also used to a considerable extent, as it lowers the melting point of gold very considerably, but it renders the gold quite brittle and aids materially in the tendency of solder to burn into the work, which property is characteristic of all the so-called easy flowing solders. The term "easy-flowing" is undoubtedly a misnomer. Rather, these solders melt "easy," but do not flow "easily." They ball up and stick, and if the heat is forced to induce flow, they burn into the work with consequences too well known to require further discussion.

The value of aluminum, as a constituent of gold solders, is yet to be proved. It is a constituent of most of the patent commercial alloys used by jewelers in compounding their solders.

Solders made according to the following formulæ will be found satisfactory in color, strength, and fusing point, although higher in fusing point than the so-called easy-flowing solders, for which there seems to be a "popular" demand. They will be found to flow readily if the work on which they are to be used is brought up to the proper temperature.

FORMULAS FOR GOLD SOLDERS.

SOLDER No. 84.

	Per cent.
Gold	84.0
Copper	7.5
Silver	5.5
Zinc	3.0

M. P. 1650° F., 900° C. (20-Karat fine).

SOLDER No. 76.

Gold	76.0
Copper	11.5
Silver	8.5
Zinc	4.0

M. P. 1550° F., 840° C. (18-Karat fine).

SOLDER No. 68.

Gold	68.0
Copper	4.5
Silver	12.5
Zinc	5.0

M. P. 1450° F., 785° C. (16½-Karat fine).

The first and second, 84 and 76, will be found sufficiently low in melting point for all ordinary operations where Dr. Peeso recommends the use of his No. 21 and No. 19 solder. The number 68 solder, although higher in actual gold content than the best so-called 18-K. solder obtainable, is still too low a grade to be used in general work, especially in fixed bridge-work, but may be used in connection with removable bridge-work or plate work because in that work or repair work there is required at times a lower-fusing solder.

COMPOUNDING OF GOLD ALLOYS.

Although the new series of alloys, made with practically no deviation from the formulæ which are given herein, may be purchased from the supply houses, the author considers it well to give a number of directions to those who may desire to compound the various alloys.

It is not practical to make a small quantity, especially if for plate gold or solder which is to be poured into an ingot mould and rolled. The higher the melting point of the alloy, the more necessary it is to have a comparatively large quantity, and it is well not to attempt less than five ounces for plate gold and three ounces for solder. The elastic alloy should be made in even larger quantity as it freezes very rapidly.

It is practically impossible to alloy platinum or palladium with gold in the small blast furnace which the practitioner is likely to have in his laboratory. For all alloys with platinum metals (made on the small scale previously mentioned) it is well to alloy the gold and the platinum metals (rolled very thin), first on a charcoal block, using the nitrous oxide and illuminating gas blow-pipe, or preferably the oxygen and illuminating gas blow-pipe. A number of the alloyed nuggets can then be placed in a crucible on top of the required silver and copper content, covered with a suitable reducing flux and melted, poured into an ingot mould and rolled or drawn.

When copper is to be used, it is essential that same be chemically pure and especial precaution must be exercised to prevent oxidation as far as possible, which latter can be accomplished by the use of a strong reducing flux. (See under Fluxes.)

A slight excess of copper should always be added to allow for some loss which invariably occurs.

If the alloy that it is intended to make is to be used for casting purposes, the procedure is the same as previously described, excepting that the metal, when properly molten, can be poured into a pail of water and thus granulated. This procedure saves the labor of rolling the ingot and the granulated form of gold is as convenient to use for casting as any other.

In all cases, just before pouring the contents, the crucible should be well shaken to insure a thorough admixture of the metals.

Some writers advocate the preparation of alloys for casting in the following manner: Melt the gold, feed the platinum (very thin) into the molten gold and then add copper, etc. It is impossible to make a uniform alloy in this manner, especially if copper is used, because a considerable amount of the copper is oxidized on account of direct contact with the blow-pipe flame. In the author's hands the directions previously given have been found to work out admirably.

In compounding solders where zinc and copper are the constituents it has been advocated that brass which contains copper and zinc be used in order to prevent the loss of zinc through oxidation and volatilization. This is a very dangerous practice, and the results are very unsatisfactory because it is impossible to obtain a commercial brass that does not contain a considerable percentage of lead, tin, and traces of antimony, etc., which are all very harmful substances and invariably tend to make the solder brittle. It is therefore necessary to first make an alloy of chemically pure zinc and chemically pure copper in a proportion of say one part zinc and two parts copper. This alloy, when properly melted, is granulated by pouring into water, and then, if carefully gathered, dried and weighed, the loss of zinc can be determined. The necessary additional copper to make the required alloy is then calculated and added when compounding the solder.

It is well, of course, to make a considerable quantity of the copper zinc alloy, as the cost is slight and the prepared alloy is then available when wanted. It has been stated that zinc volatilizes very readily from solders. This is quite contrary to the author's findings. The small percentage of zinc as given in the formulæ herein is quite stable after remelting several times. The authors who claim this strong volatilization of zinc may have been dealing with a solder of unknown constitution in which they suspected zinc but which probably contained a percentage of cadmium which volatilizes quite readily.

REFRACTORY MATERIALS. INVESTMENT COMPOUNDS FOR SOLDERING.

The normal contraction of gold from the molten to solid state is approximately 2 per cent. The contraction of gold solder is practically the same, although some of the constituents have a higher contraction than gold, but when combined in an alloy the movement is practically the same.

While possibly there may be a slight difference between the contraction of solder and gold, a considerable contraction occurs nevertheless, and is the cause of a great deal of trouble.

A number of soldering investment compounds on the market are claimed by the manufacturers to possess *neither expansion nor contraction, and therefore perfect.* Granting, for the sake of the argument, that such is the case, we still have the contraction of solder to contend with, and how are we to produce a soldered bridge or denture that will fit and go into place accurately, when a number of the units in the work have been drawn together by the contraction of the solder?

Unfortunately, we have not merely the contraction of the solder to contend with, but we have a much more prolific cause of disaster. For example, we have a number of completed sections, such as castings, to join together where but a very small quantity of solder is to be used, and yet, after soldering, we find that the finished piece is contracted and distorted and will not go into position. The fact of the matter is that practically all the commercial compounds shrink upon heating, when brought up to the proper temperature for soldering.

In some commercial investment compounds the shrinkage is extremely high, fully 6 or 7 per cent., so it is evident that the *principal cause of the trouble lies not so much in the actual contraction of the solder, as it does in the great contraction of the average investment, even before the case is quite hot enough to apply the solder.*

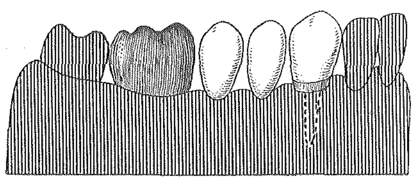


FIG. 652

Fig. 652 shows an ordinary simple bridge assembled and ready for investment. The porcelain facings are spaced as per instructions from time immemorial. Fig. 653 shows the case invested and the distinct spacing of the backings.

The case is then heated, and if an examination of the investment is made with a magnifying glass, just before placing it on the sol-

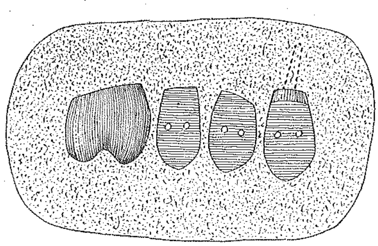


FIG. 653

dering block, it will be noticed that the *units have been drawn together,* as in Fig. 654, and when the case is soldered and cooled, the facings are very apt to be checked, on account of having been brought together into very strong contact.

When attempting to place back on the cast, difficulty is encountered, but as the plaster yields, the bridge is forced down and then becomes evident the loss of the contact points, as illustrated in Fig. 655.

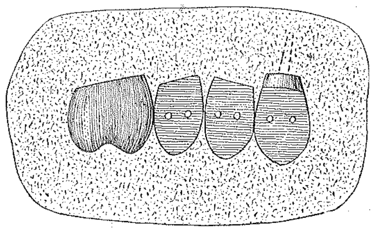


Fig. 654

This discrepancy will not be considered by some operators as a serious factor. In fact those who solder directly on the cast destroy the evidence for the time being. If it is a fixed bridge, it is forced home some way or other and let go at that, but on the other hand, if a removable bridge, even as small in dimension as the one illustrated, it is practically impossible to place it in position, and the matter is a most serious one, as a good many operators have found.

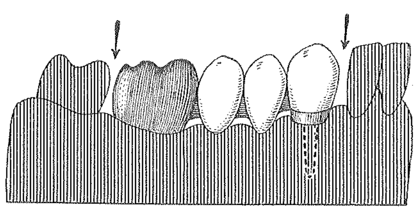


Fig. 655

Some writers advocate completing the dummies and then placing them in perfect contact to prevent the shrinkage of the solder used to unite the sections. This is practically impossible, because the metallic units are infinitely stronger than the investment, and expanding under heat will invariably split the investment (see Fig. 656) and thus often cause a serious distortion in the soldered piece.

There seems to have been, as a search of the literature has shown, absolutely no consideration given to the movement of the refractory mass that holds the parts *in situ* during the preliminary heating and final soldering operations.

The author's aim in experimenting has been not merely to produce an investment compound that would merely not shrink, but one that would *actually expand*, move in unison with the solid invested metal and *spread the units* sufficiently so that when a reasonable amount of solder is flowed to connect the units, the *contraction of the total piece would be neutralized by the expansion of the investment.*

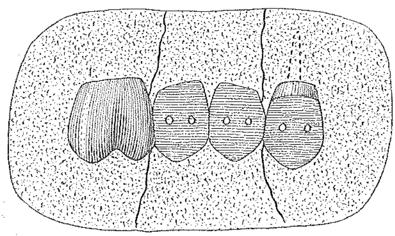


FIG. 656

Before attempting to formulate an investment compound possessing such properties, it is necessary to consider the chemical and physical properties of refractory materials that may be employed in the compounding of investment materials.

In one of the most "popular" books on crown and bridge-work,[1] the following appears:

"Many substances may be used in combination with plaster of Paris, which is necessarily the basis because imparting the property of crystallization, and which must be incorporated to the extent of at least 50 per cent.

"The remaining proportion may be then composed of such materials as will, by virtue of their characteristics and physical properties, meet such requirements. The following are serviceable:

Powdered silex,	Pulverized pipe clay,
Fine asbestos,	Powdered fire brick,
Beach sand,	Magnesium oxide,
Marble dust,	Pumice stone.

"A combination of any of these ingredients in varying proportions with the proper quantity of plaster will usually possess the necessary qualities, etc."

Before even considering a compound of *expanding properties*, it is well to thoroughly understand the properties of plaster of Paris

[1] Goslee's Principles and Practice of Crown and Bridge-work, pp. 36–37.

and the other materials enumerated in the list of suitable refractories, in order to see if it is possible to even produce an investment compound that will *at least not shrink under heat.*

Plaster of Paris.—Plaster of Paris, $CaSO_4$ (calcium sulphate) is made by burning gypsum rock. In the process of burning, most of the water is driven off. The phenomena of recombining with water and crystallizing is well known and need not be discussed here. It is universally used as the binder for all investment compounds used both for soldering and casting. It *shrinks very considerably upon heating*, but for want of a better material must be employed.

The *more plaster* used in an investment compound, the harder the resultant mass will be, and the *more shrinkage* will take place. As will be shown subsequently, any *such proportion as the* 50 *per cent. mentioned by the author quoted is absolutely out of question* because it has been found, so far, impossible to compensate for the contraction of the binder, by the addition of any other material, even if possessing the property of expansion.

Powdered Silex.—Silex is the commercial term applied to silicon dioxide (SiO_2) which is the main constituent of rocks, stones, clays and many other minerals. A great deal of it is also found in a free state and in the form of quartz, rock crystal, flint, opal, chalcedony, etc. The so-called silex is often practically pure SiO_2. However, different varieties of silicon dioxide exist, and although all of a similar chemical composition, they possess varying physical properties.

Silica obtained from quartz or rock crystal, consists of sharp crystalline particles and possesses a high specific gravity, 2.6 to 2.8. It expands considerably upon heating, but loses this property gradually upon reheating frequently or fusing completely.[1] The melting point of pure silica is approximately 3200° F.

Another variety of silica that exists quite as frequently as the crystalline, is an amorphous form which possesses a lower specific gravity, 2.2 to 2.4. It has very little expansion upon heating, and some varieties of the same type do not expand at all.

Still a third variety exists in a tabular form and is extremely light and porous. It is known as diatomaceous earth or kieselguhr. Its specific gravity is 1.6 to 1.8. It is mined in very great quantities

[1] Utensils made of fused silica are replacing platinum ware to a great extent in chemical work. As the coefficient expansion is very small (0.00000054 per ° C.) it is possible to subject crucibles, casseroles, etc., to rapid changes of temperature without danger of breakage. Apparatus suitable for dental purposes is manufactured by the Thermal Syndicate Ltd., of New York.

and used very extensively as a heat-insulating agent, but contracts very strongly, and therefore is totally unfit for use as part of a dental refractory compound.

As stated before, these various forms of silica can be obtained in almost a pure state and are alike chemically, but the term "powdered silex," means nothing unless a particular type is specified, and the individual, who is not conversant with the matter, is as likely as not to purchase and use a grade of least expansion. *The crystalline variety, of high specific gravity, expands under heat considerably, and in this fact lies the solution of the whole problem.*

A mixture of 50 per cent. plaster of Paris and 50 per cent. silica, even if the latter is of the variety possessing the highest expanding properties, contracts very considerably when brought up to the temperature required for soldering or casting operations.

In order to be brief, the author will state that all the other items in the list of suitable materials have a positive shrinkage, with the exception of beach sand. The objection to the latter, is the fact that it is often quite impure and the iron and alkalies that form the major portion of the impurities usually act as a flux, and thus lower the melting point.

It is well to state that magnesium oxide and marble dust, which latter is of course calcium carbonate, are subject to a particularly strong contraction under heat.

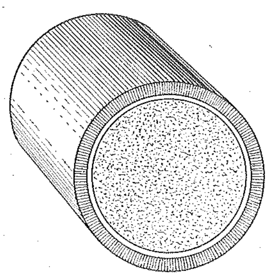


Fig. 657

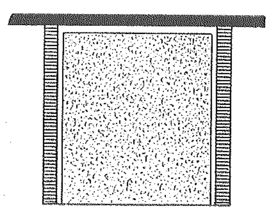


Fig. 658

Fig. 657 illustrates the comparative shrinkage of one of the best commercial compounds obtainable. A considerable space will be noted between the mass of investment and the rim of the metallic ring in which it was placed after mixing, permitted to set, and heated to soldering temperature.

Fig. 658 (in cross section) shows even more clearly the contraction after heating when a straight edge is placed across the top of the flask.

To summarize the whole proposition, the author will state that *in order to produce an investment compound that not only does not shrink, but actually expands sufficiently to follow the movement of a red hot ring, that it is necessary to use a grade of silica as pure as possible and of the highest expansion, which means, of course, a grade of silica from the quartz group, and a grade of plaster of Paris of the least contraction.*[1] *As previously mentioned, any such proportion as 50 per cent. plaster cannot be used, because the expansion of the best silica, great as it is, is not sufficient to compensate for even the shrinkage of the plaster. Hence, a lower percentage of plaster, and a higher percentage of silica must be used.*

FORMULA FOR INVESTMENT COMPOUND (SOLDERING).

	Per cent.
Plaster of Paris (Excelsior Brand No. 3)	33.0
Silica (Fine) (F. F. F.)	45.0
Silica (coarser) (M. C.)	22.0
Total	100.0

A compound made according to this formula will be found to expand upon heating to soldering temperature, sufficiently to fill a red hot ring, as in Figs. 659 and 660.

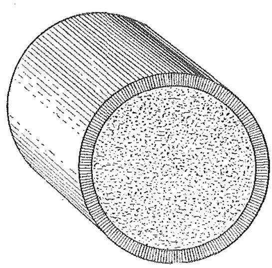


FIG. 659

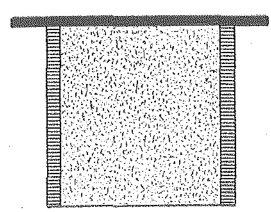


FIG. 660

This property of expansion is sufficient to *counteract the contraction of a normal bulk of solder.* Furthermore, this expansion is sufficient to *follow the movement of invested metallic sections that have been previously completed.* This compound sets promptly and is sufficiently strong to hold the invested parts *in situ* firmly. It will withstand the action of boiling water (when washing out the wax) without disintegration.

[1] It is, no doubt, well known that fine plaster contracts more than coarse plaster when subjected to heat. Most of the coarse building plasters are rather ununiform and do not possess the binding power of the finer plasters. The grade selected is quite uniform and not too coarse to prevent efficient binding of the mass.

Dr. Peeso has long ago demonstrated the great importance of not soldering work directly on the cast. The work should be so assembled that the waxed-up structure may be removed from the cast, which is made of plaster of Paris, or a more durable material, such as "Artificial Stone" (made from the author's formula), and then transferred to the investment compound. After soldering, the work may be placed back on the cast, which is intact, and required corrections can be made by grinding or trimming here and there before the structure is even tried in the mouth.

Of course the author has made numerous and exhaustive experiments to determine the properties and behavior of various refractory materials, and it is important that the grades of silica and plaster specified be used.

As the reader can deduct from the preceding, the terms silica and plaster of Paris mean very little, because while the different grades of silica are practically alike, chemically they differ very materially physically. To the author's knowledge, it is possible to purchase at least three or four hundred brands of plaster and over a thousand distinct grades of silica with varying percentages of impurities and varying sizes of particles.[1]

There is no intention to claim that this is the last work on the subject. No doubt, other experimenters will succeed in producing as good or even a better compound with other grades of material.

Investment Compounds for Casting.—The elements of error, caused by the physical behavior of the metallic alloys and the refractory materials utilized in the casting process, are quite analogous to the conditions that exist in the soldering process. Gold, no matter how alloyed, so far as present knowledge of the subject indicates, *does contract* in the transition from the fluid or plastic state to the solid or frozen state, and an inlay investment compound that possesses the property of expansion will, at least in measure, compensate for the contraction of gold.

It is not the author's aim here to exhaustively discuss casting problems in general. He simply wishes to suggest a formula for what he considers a better investment compound than is purchasable, and to point out some of the physical phenomena of existing

[1] The materials used by the author were obtained from W. B. Daniels, 252 Front Street, New York City, who is a dealer in minerals and chemicals. He will supply the various ingredients for both the soldering and casting compounds in quantities suitable for the requirements of the practitioner. Of course it must be remembered that such comparatively cheap materials are, as a rule, sold by the ton or car load. Hence, Mr. Daniel's willingness to furnish these materials in small quantities at a moderate price deserves commendation.

conditions. Before discussing the formula it is well to first consider some of the conditions that have to be dealt with. We have not only the contraction of gold to contend with, but we also have the contraction of the wax, and that is a most serious factor indeed. *The contraction of wax is usually productive of a greater degree of error than the actual contraction of gold.*

This subject has been covered most thoroughly by Dr. C. S. Van Horn of Bloomsburg, Pa., in his articles in the *Dental Cosmos,*[1] and his conclusions are yet to be controverted.

The conditions, which he successfully corrects, are the following: *After the removal of a wax pattern from the mouth, at body temperature, it contracts considerably upon reaching room temperature and still more when invested with cold water.* His method consists of *investing the pattern at approximately* 110° F., *which* increase in temperature not merely compensates for the contraction of the wax, but also expands the wax to *almost completely counteract the shrinkage of the gold.*

In addition, he uses an expanding investment (made from the author's formula), and the total expansion of the wax, coupled with the expansion of the investment, enables Dr. Van Horn to produce the most accurate fitting inlays the author has ever seen. A study of Dr. Van Horn's technic will amply repay anyone who is desirous of obtaining better results.

Dr. James G. Lane,[2] of Philadelphia, was among the first to point out the value of silica as an ingredient of inlay investment compounds, on account of its expansion and consequent ability to counteract the contraction of plaster of Paris (the binder). The formula that he used (plaster 25 per cent. and silica 75 per cent.) expands considerably. In addition, Dr. Lane was also among the first to point out the fact that a hot mould was stronger than one that was heated and allowed to cool.

In the utilization of the casting process, there are a great many important factors to be considered, among them the *fusing point of the investment compound which constitutes the mould; the relation of this degree of fusibility to the temperature of the mould at the time the molten metal enters it; the temperature of the molten metal at the time it enters the mould and the pressure used to force the molten metal into the mould.*

[1] Dental Cosmos, 1911, pp. 664, 472, 1109. 1912, pp. 890, 973. 1914, p. 940.

[2] See papers of J. G. Lane in Dental Cosmos and Dental Digest, 1910–14. Also M. A. Ward in Dental Cosmos. These contributions are very interesting and the most valuable that have appeared pertaining to the subject.

The fusing point of an investment compound, made of plaster of Paris and pure silica, is under 3000° F. Some of the commercial investment compounds, which are made with impure silica containing a considerable percentage of iron and feldspar, which latter contains alkalies such as sodium and potassium, are often considerably lower fusing. Consequently, when superheated gold is cast into such a comparatively fusible investment, a partial union is bound to take place, with the consequence that the gold partly unites with the investment, and the resultant casting is quite rough and inaccurate.

The strong possibility of such a condition as described leads the author to state his opinion on that apparently never-ending controversy regarding the casting of gold in a *hot or cold flask.* This point has been argued time and time again, some operators claiming that they obtain better results by casting into a hot flask, and others maintaining the reverse. In order to discuss the subject intelligently, we must also bear in mind the degree of heat that is utilized for melting the metal to prepare for its entrance into the mould.

Let us first consider the following:

Hot or Cold Mould.—*Using the illuminating gas and compressed air blow-pipe.*

We shall discuss this phase first because the great majority of castings are accomplished by using the ordinary gas and air blow-pipe. The maximum temperature that it is possible to produce with artificial gas and compressed air is approximately 2450° F. The temperature of the investment in the casting ring when red hot is about 1300° F. If this red hot flask is placed on the casting apparatus and the quantity of gold, say 5 dwts., placed in the crucible, it will take about two and a half minute's exposure to an efficient blow-pipe flame, to bring the gold to the proper state of fluidity to enter the mould. In the meantime, the red hot mould (on the casting apparatus) has cooled considerably, and the actual temperature of the cavity in the mould at the time the gold enters it can be safely calculated not to exceed 900° F. Therefore, casting into a "red hot flask," with an ordinary gas and air blow-pipe, is done with the mould not red hot, but at a temperature approximately 900° F.

In casting into a so-called "cold" flask using the same blow-pipe and quantity of metal, it will be found that it takes longer, say four minutes, to bring the metal into a state of fluidity, and although the flask is at room temperature when the process of melting the gold is started, the subjection of the mould to the flame of the efficient blow-pipe for a period of approximately four minutes raises the temperature of the mould to an extent of nearly 700° F, Therefore, when it is attempted to make a casting with the ordinary gas and air blow-pipe in a so-called "cold flask," the temperature of the mould at the time the gold enters it is approximately 700° F.

Upon considering both conditions and comparing the temperature of the moulds, namely 900° and 700° F., it will be readily seen that there is *comparatively little difference between the two* at the actual time that the casting is done, and consequently both the "hot mould" and "cold mould" advocates are right, strange as that may appear, providing of course, that the ordinary gas and air blow-pipe is employed.

The author's experiments along this line have shown conclusively that it is hardly possible to superheat the gold with an ordinary gas and air blow-pipe or bring the gold to such a temperature that it will unite with the investment at any stage of the procedure and it is the author's firm opinion that in the hands of the careless or inexperienced operator, the *ordinary gas and air blow-pipe is a positive insurance against superheating* the gold, and therefore insures a casting satisfactory, at least as far as errors consequent to the superheating of gold are concerned.

Hot or Cold Mould.—*Using illuminating gas and nitrous oxide or oxygen blow-pipe.*

Here we have a totally different and quite often a dangerous condition to contend with. While the ordinary gas and air blow-pipe is capable of producing temperatures only somewhat beyond 2400° F., it is possible to obtain, without difficulty, 3400° to 3500° F. from nitrous oxide and illuminating gas and over 4000° F. from pure oxygen and illuminating gas. It may be well at this time to call attention to the fact that the often used term "oxyhydrogen" is incorrect when used in connection with illuminating gas because of the fact that in order to produce an oxyhydrogen flame it is necessary to have both oxygen gas and hydrogen gas, whereas ordinary illuminating gas contains less than half of its volume of hydrogen, and the balance is principally methane (carbon, etc.).

It is very difficult to avoid superheating gold when applying such extreme temperatures, and extreme caution must be exercised by the operator.

As a rule, the cold flask is indicated when using extreme temperatures for melting the gold, because the gold melts very rapidly

(15 to 20 seconds), and comparatively little heat is transmitted to the mould. The mould is then comparatively cool, and even if somewhat superheated gold is cast, it is not so apt to unite with the investment as when both the gold and the mould are superheated.

The author has very often made failures of castings, on account of superheating the gold, and he wishes to impress strongly the fact that extreme caution must be exercised in this connection.

The nitrous oxide or oxygen and gas blow-pipe offers advantages over the ordinary gas and air blow-pipe as a means of producing heat rapidly, but the maximum temperature attainable with the ordinary gas and air blow-pipe acts as a sort of an insurance against superheating, and, in fact, if efficiently used produces satisfactory casting results in all ordinary operations.

One of the most prolific causes, in fact, probably the greatest cause that is productive of faulty castings, is the excessive pressure used in forcing metal into the mould. The principal reason for this is due to the fact that in the majority of casting apparatus there is no provision for obtaining a definitely measured and indicated amount of force. It takes just so much and no more pressure to force gold into a given mould, and hold it there until solidification begins. Excessive pressure will not, under ordinary conditions, prevent the normal contraction of gold, because the *mould into which the gold is cast yields, and hence will distort in the same proportion as excessive pressure is applied.* It may be true that a pressure *of* 2000 *pounds per square inch may totally prevent contraction, but where is the mould that will stand that pressure?*

It is unfortunate that more operators do not realize the true value of an efficient casting apparatus such as the Taggart, and the false economy resulting from the use of an intrinsically faulty or makeshift device.

By using a grade of silica of *maximum expansion,* and a grade of plaster of *minimum contraction,* it is possible to produce an investment compound as follows:

FORMULA FOR INVESTMENT (CASTING).

	Parts.
Plaster (Excelsior Brand No. 3)	29.0
Silica (Fine) (F. F. W.)	71.0
Total	100.0

The plaster is the same as is used in the soldering investment. The silica is similar to the fine grade utilized in the soldering investment formula, but it is purified, and combines with water readily without releasing dirt, scum, etc.,[1] and consequent bubbles. An investment made from this formula will be found to expand slightly more than Dr. Lane's formula, although the plaster of Paris content is higher, and for the same reason somewhat stronger, and more resistant to excessive pressure.

Compounding of Investment Materials.—It is a well-known fact that very few commercial investment compounds are uniform in composition. In other words, although the manufacturers claim that their formulæ are adhered to, there appear variations in batches purchased at different times. This is due to the fact that insufficient attention is paid to testing the different batches of raw material, and also to the faulty compounding due to the large quantities mixed at a time. One commercial preparation has been found, on the contrary, quite uniform, for the simple reason that the manufacturer pays especial attention to the testing of the raw materials and compounds, the mixture in comparatively small quantities (200–300 lbs. to the mix).

In mixing the plaster of Paris and silica, it is not necessary to do any sifting, because the specified materials may be obtained evenly and definitely graded. All that is required is a *thorough mixture without excessive trituration.*

A very efficient small mixing apparatus may be obtained from The J. H. Day Co., Cincinnati, Ohio. It is known as the "Hunter" (experimental size), and will handle from seven to eight pounds of material. The ingredients are weighed out, placed in the container, and the apparatus revolved slowly for twenty-five or thirty minutes. This produces a uniform and intimate mixture without crushing or grinding the plaster. This point is very important, and if smaller quantities are mixed in a mortar, it is important to use very light pressure in order not to crush the plaster particles. The mixed material, of course, should be properly stored and protected against moisture.

Investments, Directions for Use.—The soldering investment should be mixed quite thick. The thicker, the better, up to a certain limit, of course. If mixed too dry, the plaster-of-Paris content does not obtain sufficient moisture to crystallize properly and act efficiently. A good consistency is 42 to 43 grammes powder to each 15 c.c. water or 27 dwts. (Troy) to ½ fluid oz. water.

[1] Bubbles and froth produced upon attempting to combine investment compound and water, are often caused by dirt or such impurities as mica, etc., contained in the silica.

The inlay investment should be mixed in a proportion of 35–36 grammes powder to 15 c.c. water, or 23 dwts. (Troy) powder to $\frac{1}{2}$ fluid oz. water. This quantity is sufficient to fill an ordinary inlay flask.

These proportions produce a mixture that allows ample time for manipulation, provided considerable time is not spent in adding a little more water, a little more powder, etc. *The setting time of the plaster naturally controls the setting time of the whole mixture, and as the action of retarding agents, added to control the set of plaster is sometimes indefinite, and often harmful, it is advisable not to attempt to interfere with the normal setting time of the plaster.*

The compound, if mixed without any unnecessary delay, sets sufficiently slow for all ordinary operations. It is the author's practice to have on hand a number of cork-stoppered bottles containing the dry compound (weighed), and a number of rubber-stoppered vials containing water (measured). The accurately-measured powder and water are thrown simultaneously into the mixing bowl, and having no bubbles or froth (as with graphite compounds)[1] to contend with, the mix can be made ready for use in from 30 to 40 seconds, thus allowing ample time for coating the pattern and imbedding in flask.

This method is superior to using the automatic weighing apparatus furnished by some of the compound manufacturers, as they are often either inaccurate or not sufficiently "flexible."

It is not advisable to attempt to invest more than one pattern at a time.

Another advantage in using measured and stored water lies in the fact that it is, when used, at room temperature, and not at hydrant temperature, *and the room temperature water does not induce a further contraction of the wax pattern during the process of investing.*

Heating of Investments.—The soldering investment may be heated quite promptly upon setting. Boiling water does not affect it materially and the wax may be washed out thoroughly, the case fluxed and immediately placed on the heat, moderate at first and

[1] Most of the compounds that contain flake graphite are very difficult to mix on account of the air content in the flakes and their tendency to "float." Such a compound requires a considerable period of time to mix, and therefore a retarded plaster is usually employed. Nodules, or "ghosts" on castings, occur frequently because the material is not "dormant" until "set." One manufacturer of such a compound claims that it is the plaster and not the graphite that causes the bubbles. This statement appears quite contrary to the facts. Kerr's "Graphite" Investment is made with previously-treated graphite and it is the best graphite investment that the author knows of.

then brought up quite rapidly to a good red heat prior to the actual soldering operation.

It is the inefficient and insufficient heating of the invested work that is partly to blame for the "popular" demand for "easy-flowing" solders. Properly-heated investments facilitate the flow of normal or even high-fusing solder.

A small quantity of potassium sulphate or sodium chloride may be used to hasten the setting of the investment, but that is rarely, if ever, necessary because it sets quite promptly if mixed to the proper consistency.

The inlay investment should be permitted to set for at least thirty minutes, to insure a fair crystallization (so-called "initial set") of the plaster. The flask should then be placed over a low heat and kept there until the moisture disappears and the wax begins to diffuse and carbonize. The heat is increased somewhat, during the latter part of this operation, and still further increased until the mould is brought up to either a dull red heat (for cold mould) or a bright red heat (for hot mould).

The initial stages of heating must be at a temperature that will not permit the wax to run out of the mould, as it is important that the wax be absorbed in the mould. Forced heating and a generation of steam during the initial stages of the drying process will force the wax out of the mould and produce a rough interior, which in turn will show its effects upon the casting, the resultant casting being rough, incorrect, and usually unfit for use. It is, of course, essential to confine and concentrate the (higher) heat in order to bring the mould to the proper temperature within a reasonable period of time.

Prolonged heating of the investment is even more dangerous than underheating, as plaster of Paris, which is the binder, *shrinks in proportion to the time that it is exposed to heat.* The total heating operation for an ordinary mould (inlay, etc.) should not exceed fifty minutes or an hour at most. It may be divided into three periods, say twenty-five to thirty minutes for low drying heat, then increased somewhat for ten to fifteen minutes, and finally subjected to the highest heat for not more than from ten to fifteen minutes.

It is permissible not to heat a case until two or three hours after the investment has been mixed, but if it is permitted to stand for a day or two, and loses all moisture, if then heated and cast, the resultant casting is apt to be very poor. It is hard to determine the actual principle involved, and it is not important to do so, but the fact does exist. In addition, under such conditions, the investment is very apt to crack or split upon heating. The author usually heats and casts into "green" moulds, but has found that a dry mould, if moistened prior to heating, appears to behave almost as well as a "green" mould. If the mould is only a few hours old it is moistened slightly, but if it is more than a day old, it is placed in water until saturated to the extent of a "green" mould.

Both the soldering and casting investment compounds are *practically immune* to "checking" or "cracking," even under the most severe heating conditions.[1]

FLUXES.

Fluxes for Soldering and Casting.—For sweating, soldering or melting metals in the construction of bands, crowns, bridges, or castings, the selection and use of the proper flux or fluxes is a matter of the utmost importance, especially if the metals or alloys used are oxidizable or volatile when subjected to heat.

Ordinary borax, or calcined borax, has been the principal flux used for this purpose. It has been almost universally used by jewelers, and the dentist has followed suit. There is, however, a considerable difference between the class of work that the jeweler and the dentist perform.

In dental soldering, we use higher grade solders and a considerably higher heat, during the various operations. As ordinary borax melts at a comparatively low temperature, it does not act as efficiently during the higher temperature stages as the requirements demand. The tendency of borax when considerable heat is applied. is to liquefy strongly, and run down to the deep portions, leaving the other portions, that it is desired to solder, insufficiently protected. Dr. Peeso recognized this long ago by using a combination of borax and boric acid, which combination melts at a higher temperature than borax alone, does not liquefy so readily, stays on the surface, protects the work longer, and is more efficient in every way.

[1] This fault is inherent in most investment compounds; the causes are numerous and principally due to the producers ignoring the physical laws governing the selection and compounding of materials for the purpose. One of the principal errors in this connection is the attempt to form a "concrete like" mass without realizing that there is a very great difference in the behavior of dental investment compounds and concrete used in building operations.

An efficient flux that has served very satisfactorily in the author's hands for a considerable period of time is the following:

FORMULA FOR SOLDERING FLUX.

	Parts.
C. P. borax glass (fused)	55.0
C. P. boric acid (not fused)	35.0
C. P. silica	10.0
Total	100.0

The ingredients are placed in a clean clay or sand crucible, and brought to a fair red heat. They combine quite readily and when quite fluid, the mixture is poured into cold water. As this glass is quite soluble, it must be removed from the water as soon as possible, dried, and pulverized to pass an 80 mesh sieve. It may be pulverized without difficulty, as the particles are very frail and brittle.

This flux may be used either in the powdered form or compounded with "*vaseline*," to form a paste, or dissolved in boiling water and the saturated solution used. In the liquid form, it will be found suitable for all general operations where the work can be heated, so as to drive off the moisture and thus leave a coating of the flux, as in bands, crowns, etc. When the work is in an investment, the grease flux will be found most useful, as it may be applied just after the case is washed out and still warm. The carrier (vaseline) flows down into the deep portions and crevices, carrying the particles of flux along. The powdered dry flux can be used on invested work under the blow-pipe when more flux is required. The strips of solder can, of course, be coated with either the liquid or the grease flux, and heated prior to use.

This soldering flux in a powdered form will also be used as the base for both the reducing and oxidizing fluxes to be discussed.

It is important that the forms of borax and boric acid specified be adhered to, because of the variable amount of water that these materials contain when purchased.

The formula of borax glass is $Na_2B_4O_7$, whereas ordinary borax, either powdered or crystals, contain a considerable proportion of water, which is evident from the formula $Na_2B_4O_7 + 10H_2O$. Therefore the borax glass is preferable to the ordinary borax containing water, because it occupies much less space, and is therefore more convenient to handle in small crucibles. However, if ordinary borax is used, the water content must be calculated and provided for in weighing out the ingredients. The boric acid used does contain water, as will be seen from the formula H_3BO_3, because it is more stable than the fused boric acid B_2O_3, and more readily obtainable. The silica should be pure, and in the form of a fine powder, so that it may combine readily. The grade (F. F. W.) used in inlay casting investment is quite suitable.

Reducing Flux.—In connection with the casting process, it is necessary to treat buttons of gold both during casting, and before recasting, with a flux that will take care of the acquired impurities. Very often there have appeared statements to the effect that a mixture of potassium nitrate and borax be used to cleanse buttons before recasting. This statement has been, in a good many cases to the author's knowledge, misunderstood. Potassium nitrate is an excellent oxidizing agent, and does remove base metals, but its use in treatment of casting buttons is contraindicated because generally, when casting gold alloys containing copper, etc., it is desired to *retain the base metal, the copper, in a reduced metallic form, and not in an oxidized form.* Consequently, if a flux is to be used, it must be of a distinctly *reducing* nature.

Reducing fluxes are used extensively in assaying and smelting operations, and their properties are well-known. In the case of casting, it is rather difficult to utilize all the benefit that may be derived from a reducing flux, on account of the difficulty of applying same to the molten metal, while it is exposed to the blow-pipe flame which *blows* instead of drives off the flux almost as fast as it is applied. Therefore, to obtain any considerable benefit from a reducing flux, it is necessary to not merely apply same while the gold is fluid under the blow-pipe, but also to sprinkle an additional amount in the manner described in the following: After placing flask on casting apparatus, place button or nuggets of gold into crucible, melt without flux until the mass of gold assumes a spherioidal form and completely covers the sprue hole. Then apply some flux by sprinkling, continue the melting until the gold is in a proper state of fluidity for casting, then remove flame, add some more flux, and instantly apply the casting pressure.

FORMULA FOR REDUCING FLUX.

	Parts.
Soldering flux (base)	40.0
Borax glass	30.0
Argol	25.0
Animal charcoal	5.0
Total	100.0

Argol is the commercial term for crude potassium bitartrate $KHC_4H_4O_6$ (cream of tartar) and has a higher reducing power than pure cream of tartar. If the latter is used, it should be increased to about 25 parts, and the soldering flux and borax glass content reduced in proportion.

A flux of this character will practically prevent the bringing into the casting, of oxidized material, and can be used to advantage in remelting and cleansing buttons of gold for recasting.

The author's procedure for this operation is as follows: After a casting is made, the residue button is placed into hydrofluoric acid for fifteen or twenty minutes, removed and melted with the blow-pipe on a charcoal block, using the reducing flux, which, in addition to reducing the oxidized copper in the button, combines with the silica, traces of which may adhere to the button. After the button is melted, and the flux used has segregated into a globule, the blow-pipe is removed and a small quantity of ammonium chloride is sprinkled on the button. As soon as the button has solidified, and while still red hot, it is plunged in dilute hydrochloric or sulphuric acid. Most of the glass formed by the flux will splinter off. If any considerable quantity adheres, it may be removed by boiling in the same acid.

Oxidizing Flux.—Potassium nitrate is a most excellent oxidizing agent and removes the base metals, the only objection being the strong fumes which are given off during the melting process. Although the operator should rarely attempt to do refining, it is well to have a suitable oxidizing flux that will not give off the objectionable fumes characteristic of potassium nitrate.

FORMULA FOR OXIDIZING FLUX.

	Parts.
Soldering flux (base)	55.0
Potassium chlorate	20.0
Sodium perborate	25.0
Total	100.0

This flux will be found useful for revivifying buttons of gold which are contaminated. It is sufficiently powerful to volatilize such impurities as tin, cadmium, bismuth, etc. It will combine with adherent investment compound and not attack copper very strongly, so that a button of gold that has been used several times and is quite sluggish and dirty, can be usually brought into good shape without difficulty.

A button treated with this flux should be cleansed in acid, as previously described, and then *remelted with the reducing flux* prior to use for casting.

In cases of refining, where a stronger action is required, the potassium chlorate and sodium perborate can be increased to obtain the same efficiency that a high percentage of potassium nitrate would give without the objectionable fumes characteristic of the latter.

It is expected that prepared flux made according to the formulæ given will be very shortly available from the supply houses. Until such time, a modification of the soldering flux formula, which also acts as a base for the reducing[1] and oxidizing fluxes, is given herewith for the benefit of those who have not the facilities for fusing and pulverizing the material. These ingredients make a flux which appears to work much more satisfactorily than ordinary borax or any of the secret preparations purchasable.

FORMULA FOR SOLDERING FLUX (SUBSTITUTE).

	Parts.
C. P. borax glass	50.0
C. P. boric acid	43.0
C. P. sodium silicate (dry powder)	7.0
Total	100.0

This is mixed thoroughly in a mortar and must be ground fine enough to pass an 80 mesh sieve.

The author trusts that his remarks upon the importance of producing castings with all the metal in a reduced form, and not in a partially-oxidized form, will be given some consideration by the reader, as this problem, on an immeasurably larger scale, has been and is one of the most important ones in the application of industrial alloys, and is being coped with successfully.

[1] There are a number of better-reducing agents than those suggested by the author, used industrially. They are not mentioned because of either difficulty of application under casting conditions, or on account of not being obtainable in small quantities. A study of the methods used in deoxidizing copper, brass and bronze, is suggested to those particularly interested.

TABLE IV.—MELTING POINTS OF THE NEW SERIES OF ALLOYS AND STANDARD DENTAL GOLDS.

° F.	Alloy.	° C.
2100	*"Elastic" Gold	1150
2975	*Plate No. 1	1135
1975	*Plate No. 2	1080
1960	Type 4 Clasp	1070
1945	Pure Gold	1063
1945	*Casting Gold "A"	1063
1945	*Casting Gold "B"	1063
1945	"Green Gold" (App. Au 80 per cent.-Ag. 20 per cent.)	1061
1900	*Casting Gold "B"	1035
1900	Light 22-K. Plate	1035
1860	Medium 22-K. Plate	1015
1860	Type 3 Clasp	1015
1825	Dark 22-K. Plate	995
1800	*Casting Gold "C"	980
1760	Light 20-K. Plate	960
1735	Coin Gold (21.6-K.)	946
1725	Type 2 Clasp	940
1650	*Gold Solder No. 84	900
1625	Gold Solder for 22-K.	885
1600	Type 1 Clasp	870
1550	*Gold Solder No. 76	840
1525	Gold Solder for 20-K.	820
1450	*Gold Solder No. 68	785
1425	Gold Solder for 18-K.	770

*The ten alloys marked " * " constitute the new series.*

They are all uniform in color with the exception of "Elastic" gold which is similar to platinum in color and Casting Gold "A" which is similar to pure gold in color.

SOME OF THE APPLICATIONS OF THE NEW SERIES OF ALLOYS IN THE PEESO SYSTEM OF REMOVABLE BRIDGE-WORK.

As will be seen from the preceding table, the series of alloys offers a large range of variation in melting point, over the ordinary alloys, thus facilitating the performance of successive soldering operations.

Construction of Bands, Floors, and Inner Caps.—As has been previously stated, coin gold is the most suitable alloy for the construction of bands, floors, etc. It is therefore necessary to use coin gold or its equivalent in the new series of alloys. The band should therefore be made of the No. 2 plate (M. P. 1975° F., 1080° C), and united[1] by soldering with the next lowest fusing alloy, namely, Casting Gold "B" (M. P. 1900° F., 1035° C.).

The floor is also prepared of No. 2 plate and soldered to the band with Casting Gold "C" (the pliers grasping the band at previously-joined portion).

The method will make, for all intents and purposes, a seamless cap. The melting point of the soldered junctions will still be considerably above that of coin gold. The tube may then be attached with the No. 84 solder.

Inner caps for telescope crowns are made in exactly the same manner. As the hardness and tenacity of the No. 2 plate is the same as that of coin gold, the same gauges of plate are to be used as with coin gold. The casting gold, if used as solder, should be of practically the same thickness as ordinary gold solder, approximate 28 gauge B & S, or preferably thinner (30 to 32 g.).

Outer Half Bands and Telescope Crowns.—After completing the inner cap and tube, the floor is made of No. 2 plate, the split pin attached to it with No. 84 solder and the half band fitted and attached with 84 solder.

For telescope crowns, the outer band is made of the No. 2 plate and the joint soldered with casting gold B. The wings are made of No. 2 plate and soldered to the band with Casting Gold "C." The cusp is swaged of No. 1 plate (higher fusing than pure gold), filled with Casting Gold "C" in the same manner as a pure gold cusp is filled with coin gold, and attached to the previously-completed outer band and wings with No. 84 solder.

If the cusp is to be cast, Casting Gold "B" or "C" should be selected according to the blow-pipe used, and attached to the contoured band with No. 84 solder.

As all of the alloys of the series used in this operation are of the same color, and the No. 84 solder is actually 20-K. fine, there will be no line of demarkation evident in the finished work.

Inlay Abutments.—The shell for the inner inlay may be cast with Casting Gold "D" and adapted to the cavity by burnishing. The tube is then soldered and the whole completed with No. 84 solder. The outer inlay matrix can then be made, using the comparatively soft, but high-fusing plate-gold No. 1, and Casting Gold "C," instead of pure gold and coin gold.

[1] See Dr. Peeso's method of band preparation for sweating.

Construction of Saddles.—The saddles, if swaged of platinum, may be reinforced with Casting Gold "B" or "C," instead of coin gold, or the saddles may be swaged of No. 1 plate (softer than No. 2) and reinforced with Casting Gold "C." If the saddles are to be cast, Casting Gold "B" or "C" should be selected according to the blow-pipe used.

Construction of Dummies.—In constructing the dummies (if all porcelain), the bases and dowels may be cast with either "B" or "C," and attached to the saddles with the 84 or 76 solder.

They may also be made by burnishing 34 g. pure gold backings to the prepared porcelain crowns, fitting and soldering dowels made of "Elastic" gold, to the backings (or boxes), and attaching the completed backings to the saddles with 84 or 76 solder.

The author cannot close without calling attention to the fact that a broad conception of the scientific principles involved in the chemical and physical behavior of the various materials utilized in connection with the construction of prosthetic restorations, is a most potent factor toward the attainment of the ideal.

He has been aided materially in arriving at the conclusions presented herein by the kindness of Mr. H. C. Ney, president of the J. M. Ney Company, who unstintingly placed at the author's command all the facilities of their extensive metallurgical works in Hartford.

He also wishes to thank Dr. Peeso particularly, for accepting this contribution for presentation under his auspices.

CHAPTER XIX.

THE USES AND THE VALUE OF RADIOGRAPHY IN CROWN AND BRIDGE-WORK.

By FRED'K K. REAM, M.D., D.D.S.,
NEW YORK CITY,

AND

RICHARD H. RIETHMÜLLER, Ph.D., D.D.S.,
NEW YORK CITY.

The first question that interests the architect or the construction engineer is the nature of the ground upon which his edifice is to rise, and no effort is spared to ascertain fully the character of the foundation and to provide by every available means its stability, thereby insuring the durability and safety of the proposed structure. It is upon the same principles that the successful crown and bridge worker calls to his aid all the means available for ascertaining the condition of the tissues, both hard and soft, before laying out a detailed plan for the construction of the prosthetic appliance to be inserted in each case. This precaution not only spares the operator the humiliation of failure, the loss of valuable time and material, and untold annoyance, but it also protects the patient against preventable inconvenience, and safeguards the public's faith in the efficiency of crown and bridge-work. The bridge worker's chief consideration, however, as in all dental operations, no matter of how apparently trifling a nature, must be the patient's health. Since Dr. William Hunter, of London, and after him scores of others have arraigned the dental profession, and especially the crown and bridge worker, for causing oral sepsis with all its dire sequelæ by their disregard of the physiologic and anatomic bases of their work, the responsibilities involved in any intervention in the human mouth are being more fully realized than ever before. The spectre of "septic dentistry" has alarmed practitioners and patients alike, especially since the findings of such investigators as Billings, Rosenow, Flexner, Mayo, Grieves, Hartzell, and others have substantiated Hunter's timely warnings.

And indeed, no other dental operation is more conducive to bringing about chronic septic conditions, locally as well as systematically, than poorly constructed crown and bridge-work. The harm done by such work of inferior quality is all the greater, since it is often not recognized until far-reaching damage is done not only to the teeth and the mouth, but to the patient's general health. A tooth lost, therefore, may be preferable to a tooth "entombed in a golden casket."

Means for Diagnosing the Field of Operation.—Before the discovery of the *x*-ray by Professor W. K. Röntgen, in 1895, and its practical utilization in radiography, a well-developed pathological sense, an intimate knowledge of general and special dental anatomy, delicate palpation, and vast experience were the only means for diagnosing the condition of the hard and soft tissues of the jaws, of the teeth in general and the abutments in special, and of the presence of apparent or obscure foci of infection; but it is self-evident that these diagnostic agents alone offered no certain guarantee for a correct diagnosis in every case. The most reliable diagnostic data are furnished by the radiograph, this reliability standing in direct ratio to the radiographer's ability in making exposures and interpreting the resultant picture. A poorly taken or incorrectly interpreted radiograph is undoubtedly almost worse than none, since an error in technic or interpretation would induce the bridge worker to proceed with his operations upon false premises. For this reason, the modern tendency toward specialization seems commendable. The average crown and bridge worker will find himself too busy to devote the necessary time and study to acquiring a perfect technic in radiography. On the other hand, his coöperation with the radiographer is indispensable; he must be able to give to the specialist intelligent directions as to the special features he wishes to have elucidated in each case, and he must be sufficiently well versed in the interpretation of pictures to recognize the pathological or anatomic facts disclosed and to suggest, if necessary, a repetition of the radiographic examination under altered conditions of position, time of exposure, or quality of rays employed. When such intelligent coöperation prevails between radiographer and bridge worker, the *x*-ray will furnish a clear insight into the conditions of the oral tissues involved in a crown and bridge operation, hence ensure the successful accomplishment of the proposed operation; it will prove an invaluable prophylactic agent against failure due to faulty diagnosis and a most important factor toward prosthetic efficiency; it will assure the patient of a correct interpretation of his case, the best possible prosthetic repair of his dental defects and adequate services for his expenditures in time and money; and it will prevent oral sepsis with all its grave sequelæ.

Books on Dental Radiography.—Manifestly, it cannot be the purpose of this chapter to teach dental radiography in all its phases and to make an x-ray specialist of every crown and bridge worker. For autodidactic purposes, we recommend such books as *Elementary and Dental Radiography*, by H. R. Raper, *Dental Radiology* by F. L. Satterlee, and a perusal of the numerous articles on this

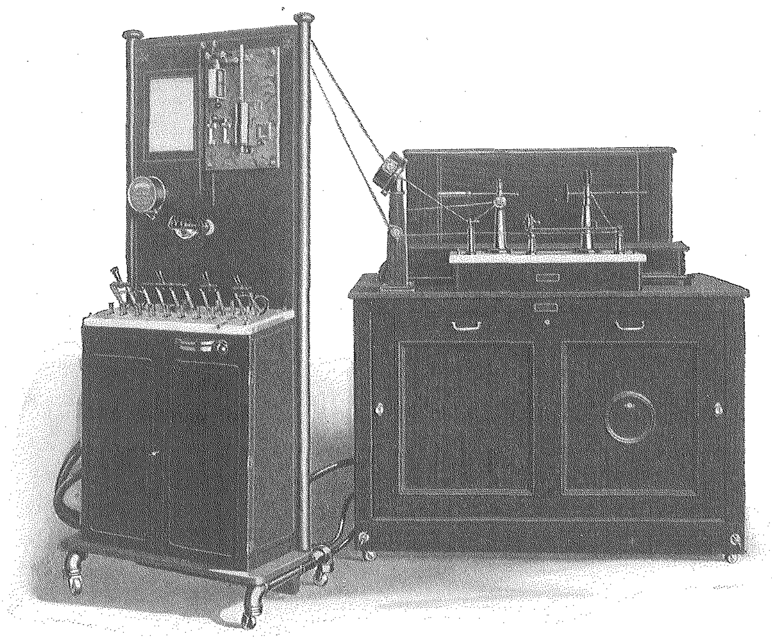


Fig. 661

subject which have from time to time appeared in dental magazine literature. The main object of this essay, which naturally must have a limited scope, is to point out in how many respects radiography is wonderfully helpful, in fact absolutely indispensable to the crown and bridge worker.

Hints Concerning Outfit, Technic, Keeping of Records, and Interpretation.—It cannot be our purpose to mention the various radiographic outfits now in the market, or to compare their relative merits and fitness for our special work. Suffice it to say that the radiographs

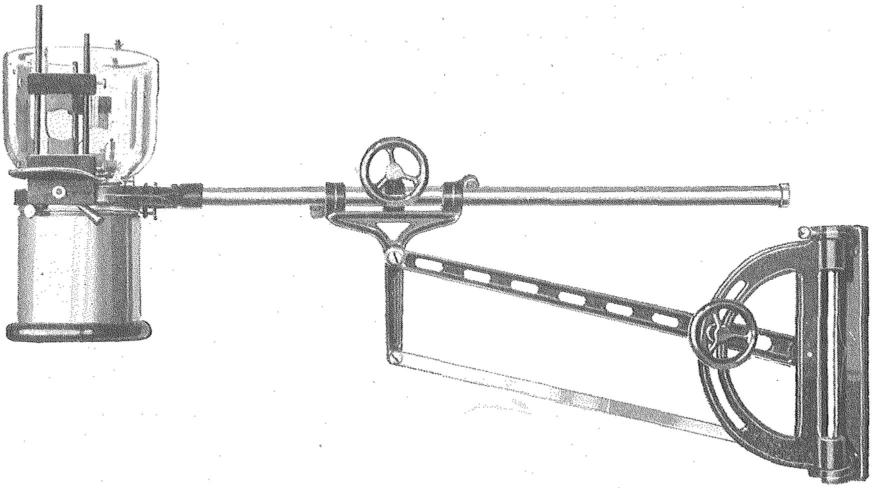


FIG. 662

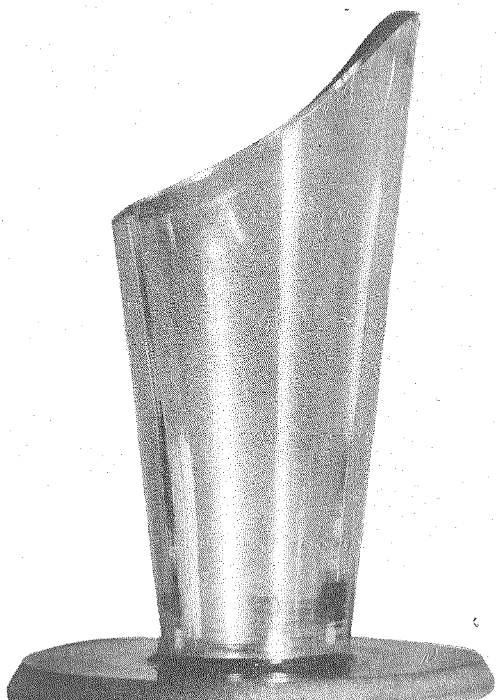


FIG 663.—Lead glass diaphragm. Cut-out suggested by Dr. F. K. Ream, and manufactured by the Scheidel Western X-ray Coil Company for making exposures for upper and lower jaws. The cut-out provides the proper angle for making exposures in the upper jaw, by holding it directly against the face. (See Figs. 664 and 665).

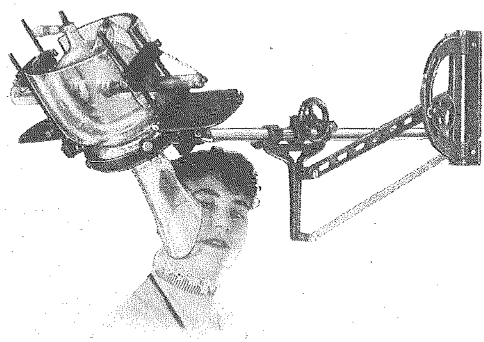


Fig. 664

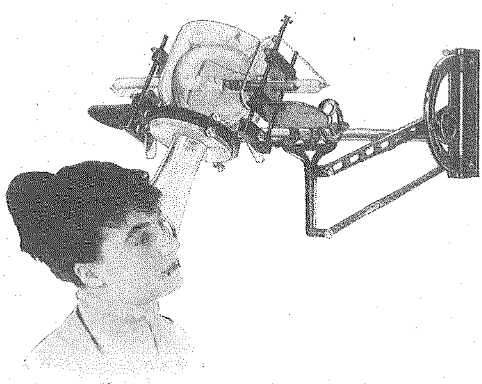


Fig. 665

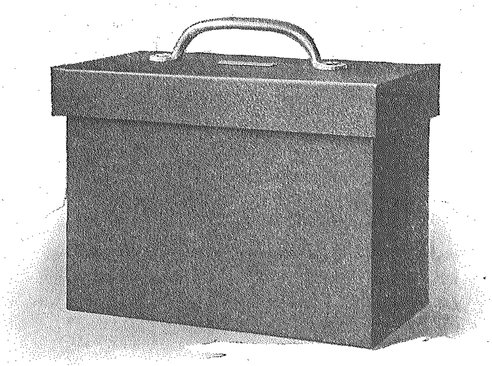


Fig. 666 —Lead box for protecting unexposed films. (Courtesy of American X-ray Equipment Company.)

shown in these pages have been made exclusively with a Scheidel Western X-ray Coil Company outfit as shown in Figs. 661 and 662, which has given entire satisfaction. As an accessory to this outfit, the cut-out led glass diaphragm, suggested by Ream and illustrated

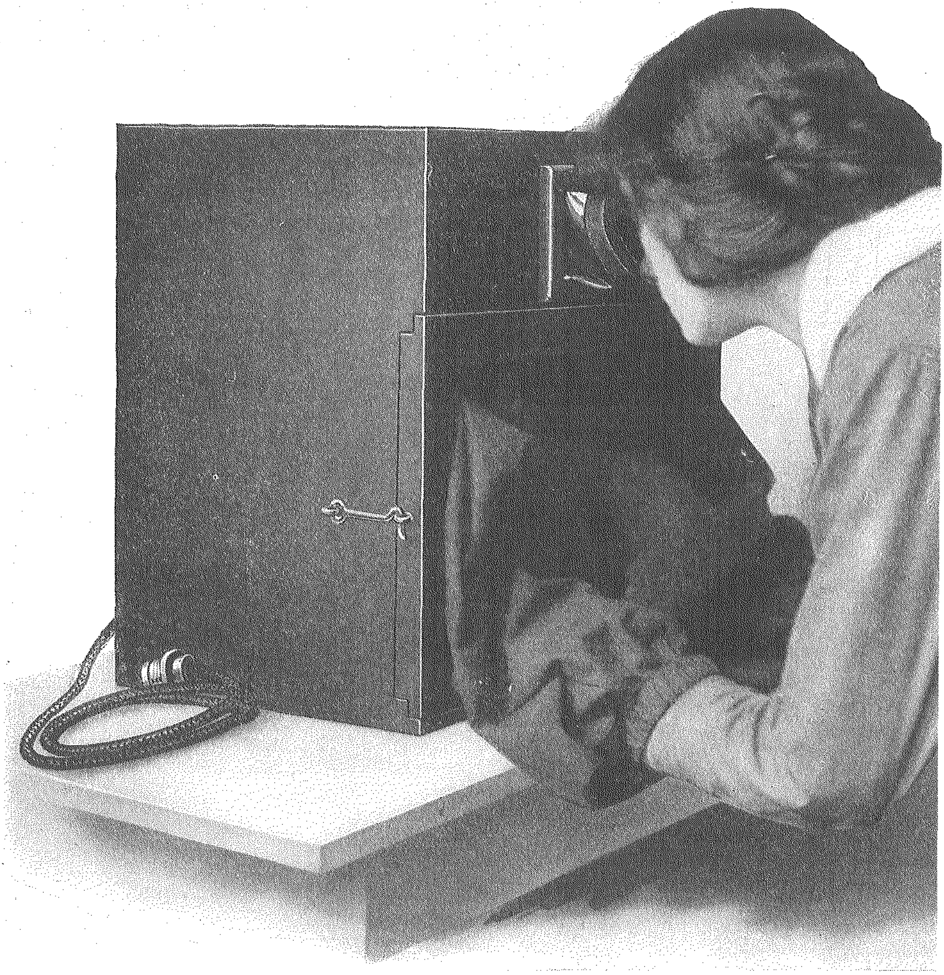


Fig. 667.—Portable dark-room box for developing films. (Courtesy of American X-ray Equipment Company.)

in Fig. 663, has proved of great help in making exposures in the upper and lower jaws. This cut-out provides the proper angle for making exposures in the upper jaw by holding it directly against the face, as shown in Figs. 664 and 665. An appliance for holding the patient's head at rest during exposures of longer duration is depicted in Fig. 676. To protect unexposed films or plates against untoward action of the x-rays, they are kept in a led box of a design

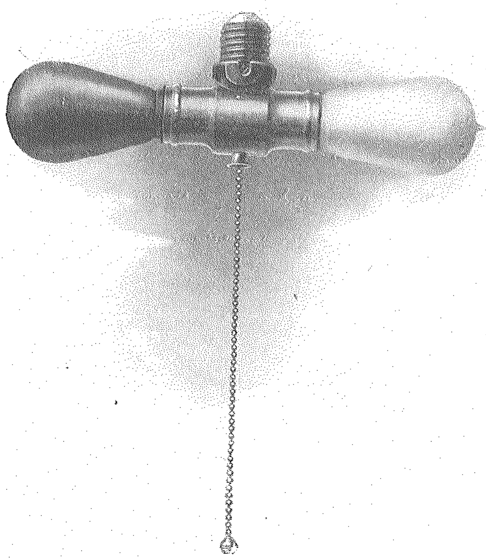


FIG. 668.—Frosted white and ruby lamp for developing and reading films respectively. (Courtesy of American X-ray Equipment Company.)

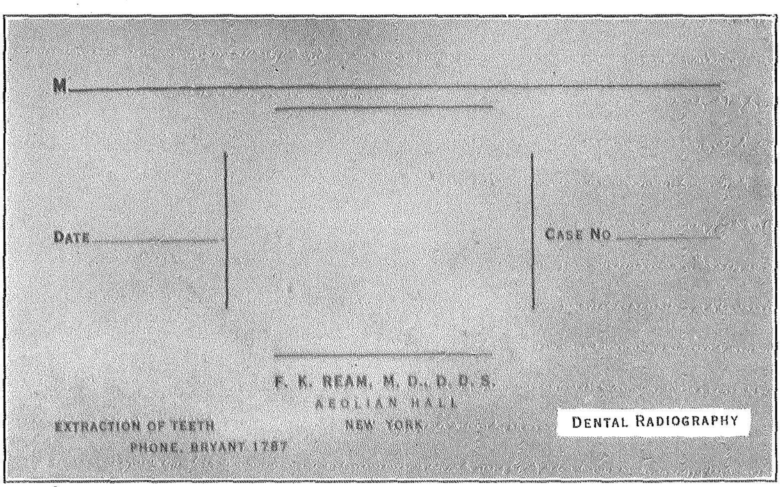


FIG. 669

illustrated in Fig. 666. The development of exposed films or plates is made according to the well-known chemical principles and routine practice adopted in photography. Since usually, development of plates or films immediately or soon after exposure is desired, both operator and patient being anxious to arrive at a definite diagnosis, the portable dark-room box for photographic development shown in Fig. 667 will prove a valuable accessory which can

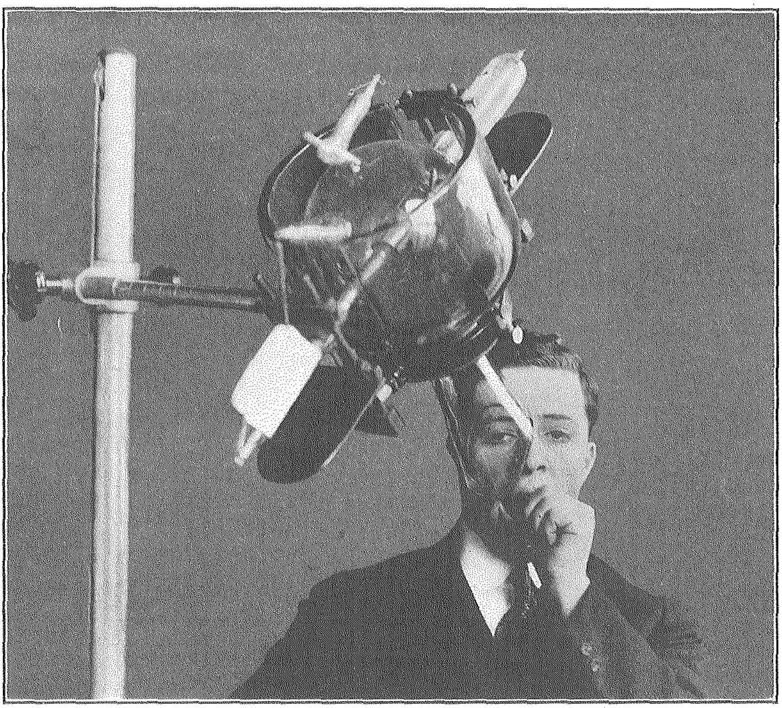


FIG. 670.—Position for making exposures of cuspid and lateral. Patient holding film in mouth.

be handled either by the radiographer himself or by his assistant after some training, as a substitute for a special dark-room. This portable dark-room box does away with the necessity of setting a room or part thereof aside as a dark-room, and is practical in every respect. For developing, if a dark-room is available, or for "reading" the developed film or plate either while it is still wet or after drying, a combination frosted white and ruby lamp, as shown in Fig. 668, is useful. A holder in card form of a diaphanous material resembling celluloid, or, better still of black cardboard (see Fig. 669), on which the patient's name, the date of exposure and the case number is written, serves as a holder for the developed film, and

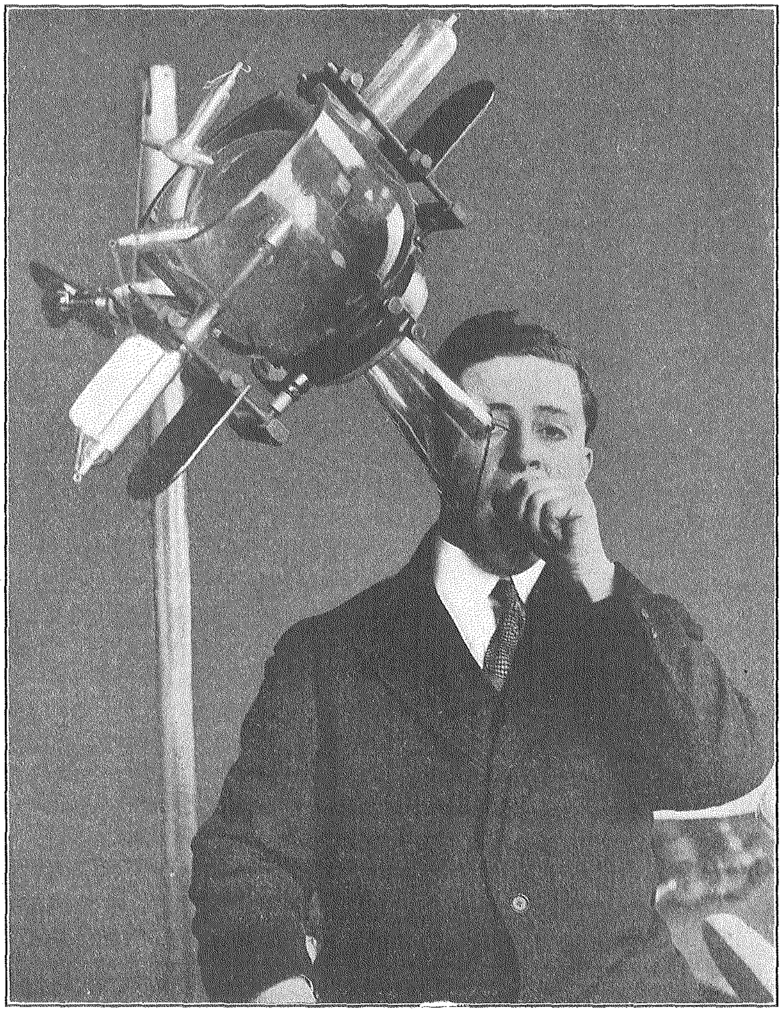


Fig. 671.—Position for taking upper right teeth, posterior to cuspid.

permits of convenient handling, interpreting, and filing of the case for ready reference. It will usually be found that the negative presents finer details than a print made therefrom, the more delicate shades often being lost in prints.

In order to obtain a comprehensive view of the field of operation in all its details, and to arrive at definite conclusions concerning the patient's dental condition and the operative measures dictated thereby, it is preferable, in fact most desirable that, instead of securing a röntgenogram of only two or three teeth, a complete series of exposures be made, thus ensuring a complete vision of

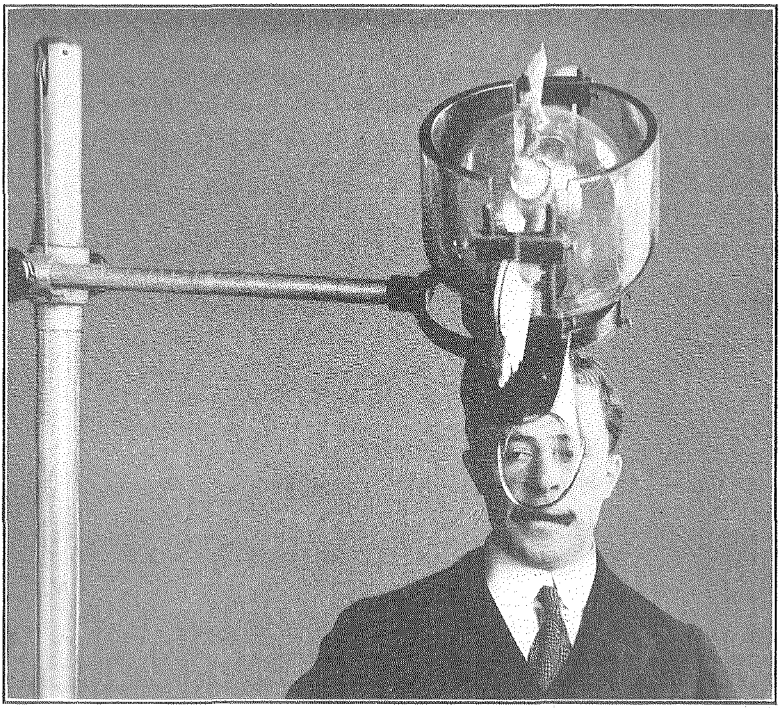


Fig. 672.—Position for taking four upper anterior teeth. Patient is holding film in mouth by closing teeth.

the field and a strategic map, as it were, by which the operative procedures will be guided.

In making exposures, the patient's coöperation must be solicited for holding the film in its proper position in such cases as are shown in Figs. 670, 671, and 674. The patient's posture, the position of the apparatus and tube, and the manner in which the patient should hold the film in the mouth when making exposures of the upper lateral and cuspid are illustrated in Figs. 670. For taking a radiograph of right upper teeth posterior to the cuspid, the various units are arranged in the positions shown in Fig. 671. Closing of the teeth for holding the film in place is resorted to in making an exposure of the upper four anterior teeth, as shown in Fig. 672. In similar manner, a large film is placed across the teeth and held in position by the patient's closed mouth in exposures of the lower anterior teeth (see Fig. 673). In taking radiographs

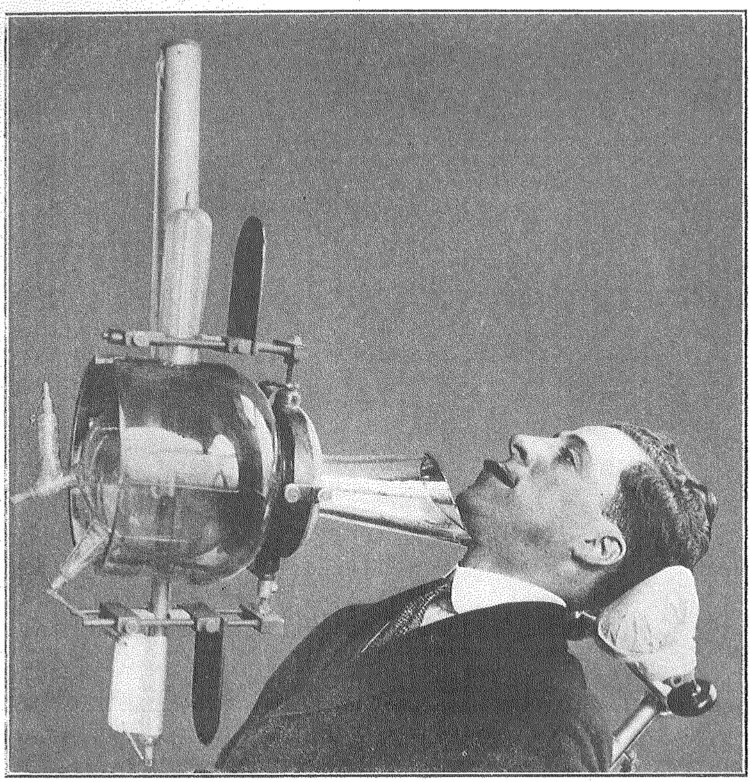


Fig. 673.—Position for taking exposures of lower anterior teeth. Large film is placed directly across the teeth, patient closing mouth and holding film in position.

of lower teeth posterior to the first bicuspid, the arrangement of the units is made as shown in Fig. 674, the patient holding the film in place with his finger. For obtaining radiographs of impacted third molars, the patient's posture must be given especially careful consideration. In such cases, the use of large plates and trans-illumination of the whole thickness of the head becomes necessary, as is shown in Fig. 675, where the patient is being examined for impacted lower third molars. In exposures of the maxillary sinus, where a longer exposure is needed, the head is held in position on the plate by a head clamp as shown in Fig. 676. The ray must be delivered directly on a line with the orbits, the edge of the cone to rest at the auditory canal. The anteroposterior position for making maxillary sinus exposures, and the manner of holding the

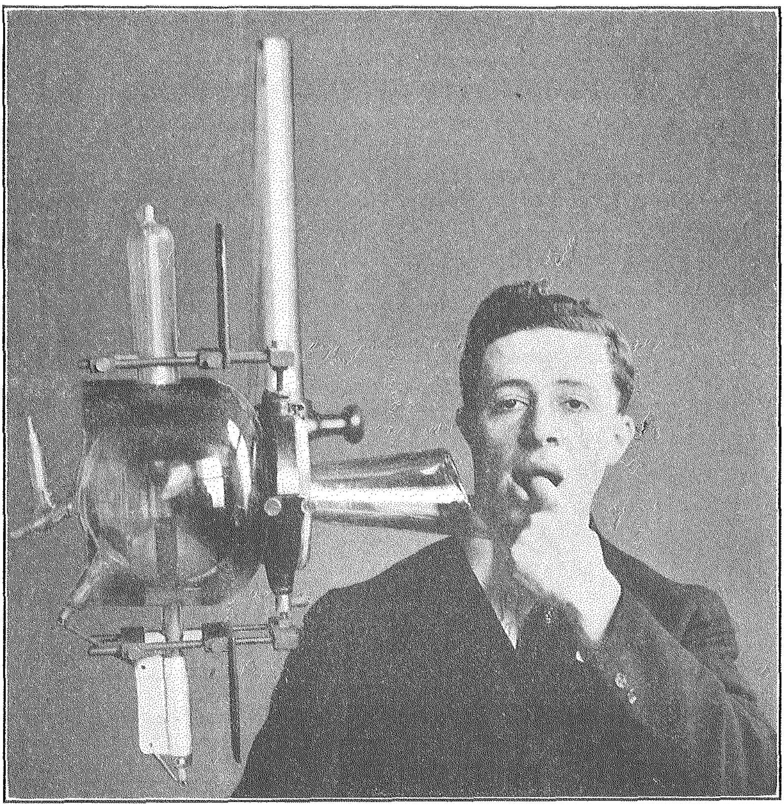


FIG. 674.—Position for taking exposure of teeth posterior to lower first bicuspid.

head firmly in position on the plate by means of the head clamp are demonstrated in Fig. 677. As an aid in securing the proper position of the head in maxillary sinus exposures, the angle recommended by Dr. F. M. Law, of New York (see Fig. 678), can be employed to great advantage.

Aside from the position of the patient's head, the arrangement of the various units of the apparatus, the angle of incidence of the ray, etc., the time of exposure and the employment of a "hard" or "soft" tube are of great importance. These latter factors are determined by the nature of the tissues to be examined and the

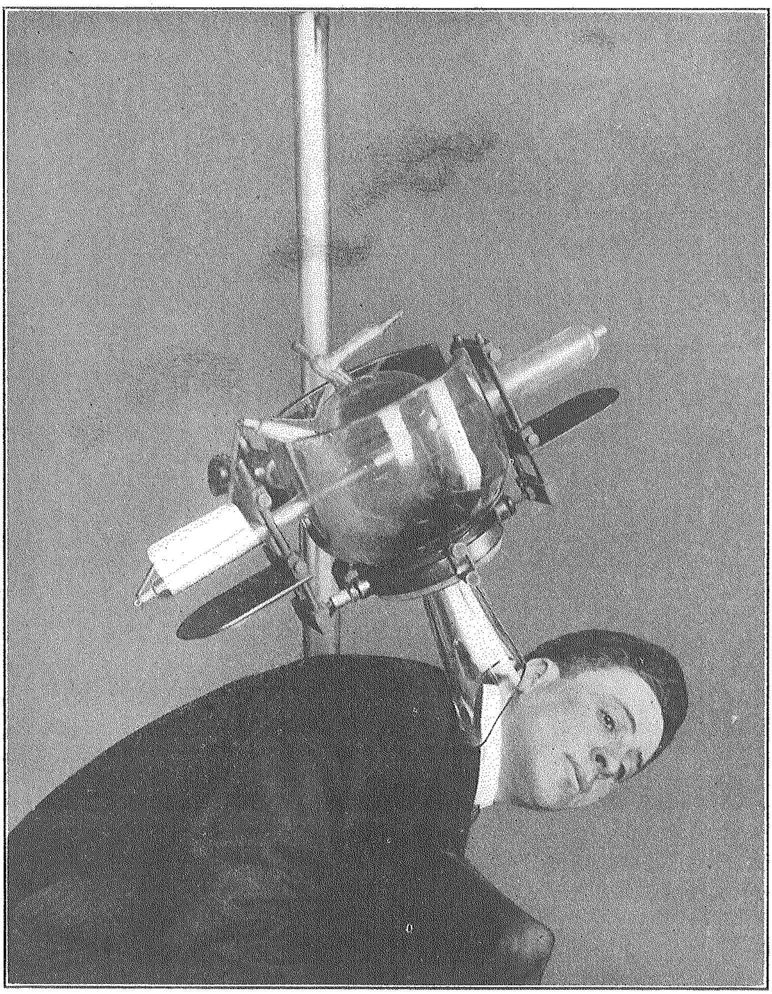


Fig. 675.—Position for taking impacted lower third molars.

diagnostic purpose of the radiograph, and their correct application and blending with the former factors are a matter of judgment and experience and constitute the chief elements of the radiographer's art. Thus it becomes apparent that the successful radiographer must combine an intimate knowledge of the anatomy, physiology and pathology of the field to be examined with a complete mastery

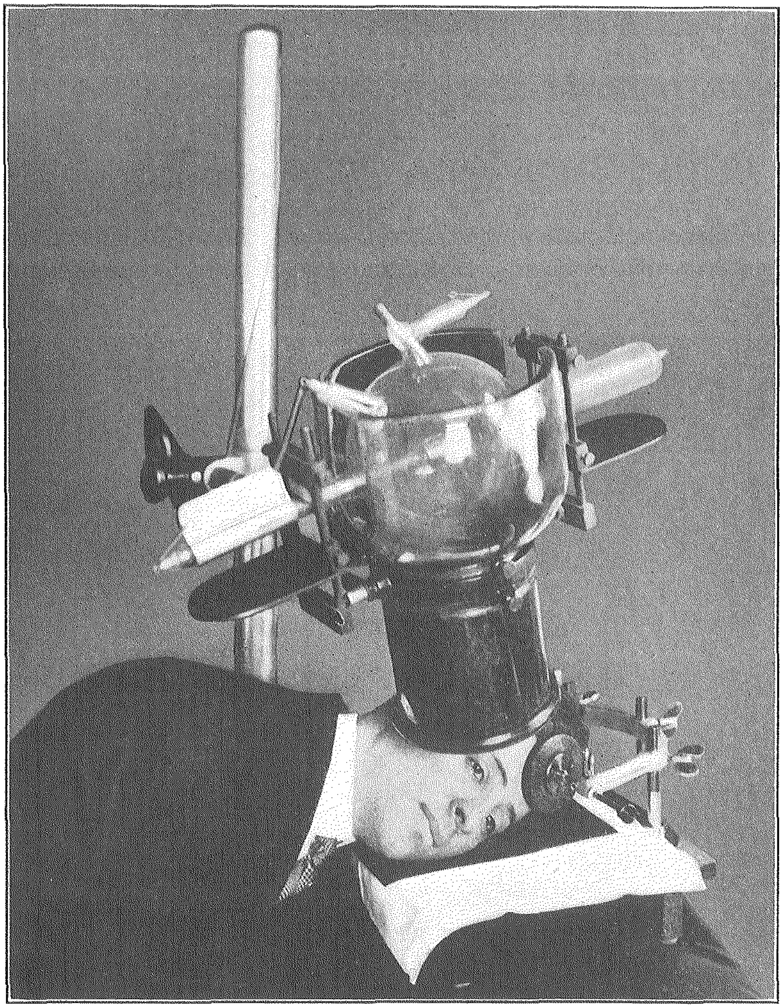


FIG. 676.—Position for taking exposure of maxillary sinus, showing head clamp and plate in position. The ray must be directly on a line with the orbits, and edge of cone at auditory canal.

of the principles of optics, electricity and radiophotography, this combination being of a complex enough nature to warrant specialization.

In the interpretation of radiographs, the questions of perspective, of distortions and of the appearance of various kinds and conditions of tissues in their normal and pathological states play an important

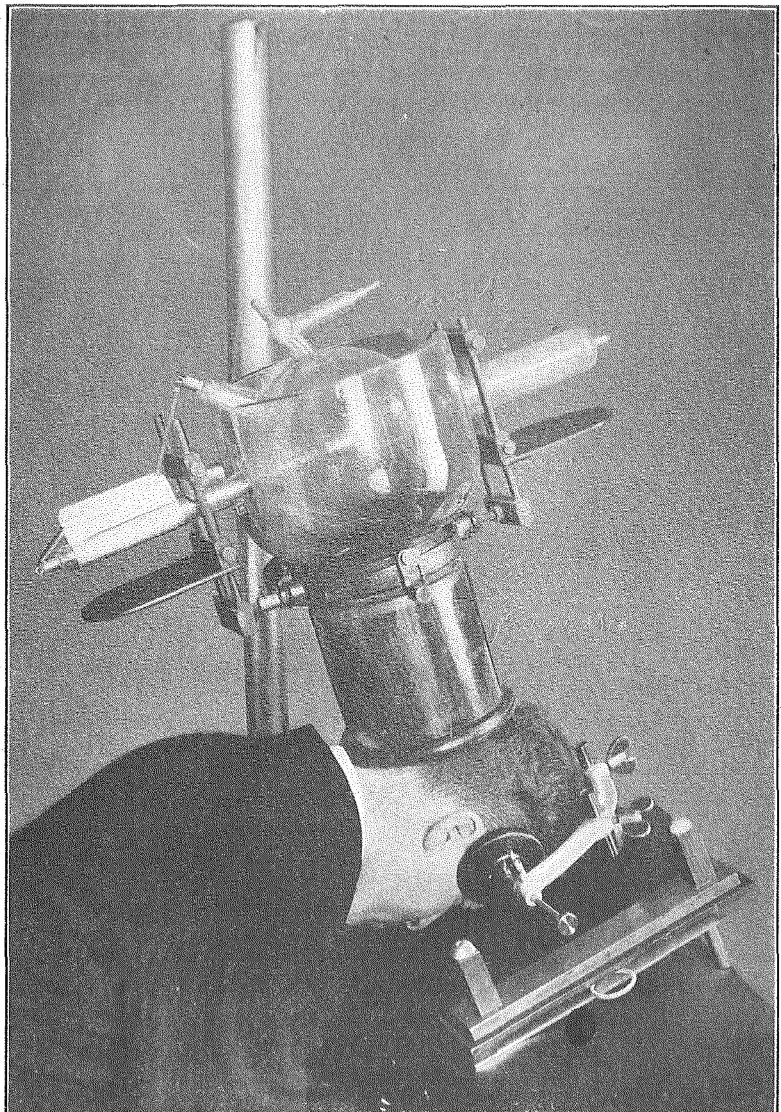


FIG. 677.—Anteroposterior position for making maxillary sinus exposures. Head clamp is in position holding head firmly.

part. The best diagnostic results, no doubt, are obtained from well-developed dense negatives which are best "read" by holding them up against a frosted electric light bulb, as seen in Fig. 668, or by laying them against the frosted glass plate of an illuminated shadow box. In thin films or plates which are so often seen, a great amount of valuable detail is lost, in fact, the diagnostic value of poor radiographs is worse than *nil,* as an entirely faulty diagnosis may result.

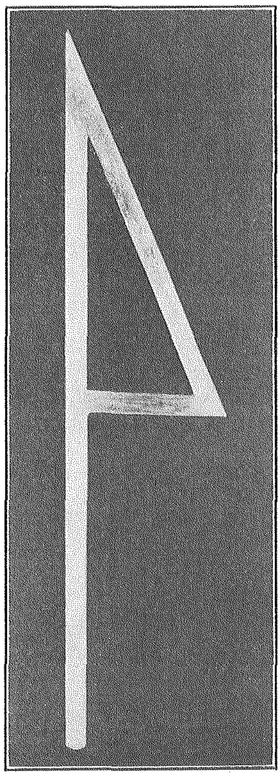


FIG. 678.—Angle used and recommended by Dr. F. M. Law, New York, for obtaining proper position in making maxillary sinus exposures.

Dangers of the X-ray to Operator and Patient.—Before proceeding to the discussion of the practical application of radiography in crown and bridge work, a word of warning should be sounded against careless exposure of operator and patient to the action of the *x*-ray. Before this action was fully understood, many cases of dermatitis, cancer, sterility, insanity, abortion, leukemia, and alopecia were reported, and the pioneer workers in this field have dearly paid the penalty for the ignorance that long prevailed in regard to the noxious influences of the *x*-ray upon the human tissues. The lamentable fate of these martyrs of science should render every operator who enters the field of radiography doubly cautious, so as to safeguard his patients' and his own health, even life. A very timely warning in this direction has been sounded by George M. Mackee, M.D., of New York City, who in an article entitled "Radiodermatitis following X-ray Examination of the Teeth," published in the April, 1916, issue of *The Dental Cosmos*, says, "The operator should realize, that in the *x*-ray we have a very powerful and dangerous as well as useful agent; and in order to avoid injury to himself and the patient, he must be acquainted with the physics and the biologic effects of the *x*-ray," and he justly protests "against anything but the most scientific röntgenology," and he urges this "not only in order to assure the future of röntgenology, but for the legal protection of the operator as well as the physical welfare of the subject."

INDICATIONS FOR THE USE OF RÖNTGENOGRAMS IN CROWN AND BRIDGE-WORK.

Coming now to individual cases of crown and bridge-work in which *x*-ray examination is not only desirable, but imperative, it is self-evident that the broad basis upon which a prosthetic restoration is to be placed must be of healthy condition, if success of the operation is to be insured. In a great many cases there may have been going on a slow progressive destruction of alveolar process in its entirety or at its borders, though the patient was not aware thereof, and purely ocular or digital examination may have revealed no extraordinary condition.

Root Resorption.—Owing to the presence of irritation of some form or other, the apical or any other portion of one or several roots which are to be employed as abutments, may have been undergoing slow resorption, thus rendering the employment of such roots of extremely dubious value as pillars for reconstructions, unless the condition is duly recognized and, if possible, such therapeutic or surgical procedures have been instituted as to restore a healthy condition. The revelations furnished by careful *x*-ray examination of such cases are illustrated in Figs. 679, 680, and 681.

Obscure Dental Caries and Pulp Exposure.—The presence of caries in a tooth which is to be employed as an abutment is not

FIG. 679. — Resorption of root ends and alveolar border in second bicuspid and first molar. Also unfilled canals and imperfect filling in first and second molars.

FIG. 680. — Destruction of alveolar support of crowned tooth that apparently was in healthy condition. This picture indicates the necessity for x-ray examination.

FIG. 681.—Complete absorption of mesial root of lower first molar.

always readily revealed by the usual methods of examination, and even if detected by these means, the destructive process with its concomitant irritation of the pulp culminating in the exposure of

FIG. 682.—Extensive caries and pulp exposure on the lingual surface of lower first molar.

FIG. 683.—Unfilled root canals, abscessed roots, and obscure caries in third molar. Lingual bar on second bicuspid.

this organ may have rendered the proposed abutment tooth unfit for a stable restoration.

The x-ray will readily reveal the presence and extent of such pathological conditions, and prevent error in judgment and failure of the reconstruction. Cases of this nature are shown in Figs. 682 and 683.

Necrosis.—The detection of rarefied or necrotic areas in any portion of the maxillæ, and especially around teeth or roots to be employed as crown or bridge supports cannot but be of vital importance both to the patient and the operator. A pathologic condition of this nature, if overlooked, would not only seriously impair the value of any restoration, but indeed greatly endanger the patient's

FIG. 684.—Necrotic area in the region of molar roots and alveolar abscess.

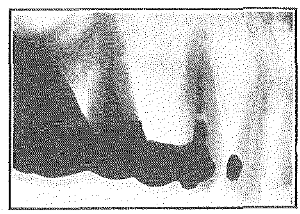


FIG. 685.—Rarefied and necrotic areas around roots of bridge supports.

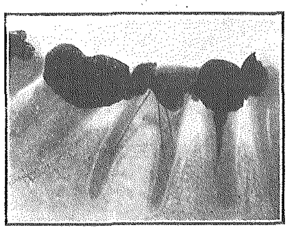


FIG. 686.—Necrotic area around the first molar and wires placed in roots for purpose of radiography.

health by imbuing him with a false sense of security. Figs. 684 to 686 are types of conditions of this description.

Impactions: Retained, Unerupted or Imperfectly Formed Teeth.—Of all teeth, the third molar is most often subject to anomalies in shape and position, and its utilization as a crown or bridge support therefore largely depends upon a recognition of its condition in each case. Impactions, as illustrated in Figs. 687 to 692 demand timely detection and prompt attention, even if the teeth thus affected play no part in the operative restorative plans, as they may in time seriously interfere with the efficiency of the restoration, and may lead to complications which would justly be blamed upon the operator's lack of circumspection. The pus areas so frequently found in connection with impacted teeth may spread to adjoining teeth, and thus become a grave danger to such teeth, also a prolific source of systemic infection.

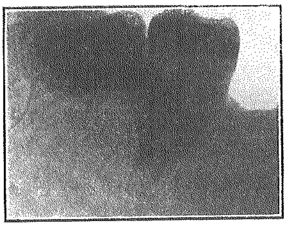


FIG. 687.—Impacted lower third molar. Owing to the age of this patient and density of bony wall, detail is lacking.

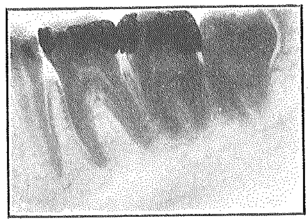


FIG. 688.—Impacted third molar, with pus area around distal surface of crown. Very prolific source of systemic infection.

FIG. 689.—Impacted lower third molar. Abscessed and unfilled root canals of first permanent molar.

FIG. 690. — Lower third molar completely imbedded in the mandible.

FIG. 691.—Impacted first bicuspid.

FIG. 692.—Transversely impacted lower third molar and cyst.

Retained deciduous teeth or unerupted permanent teeth, unless detected before the institution of restorative measures, may well destroy the most beautiful restoration, since the unfitness of a deciduous tooth for an abutment or the delayed eruption of a permanent tooth will necessitate the removal and possibly reconstruction of bridge-work. Examples of anomalies of this character are illustrated in Figs. 693 to 696.

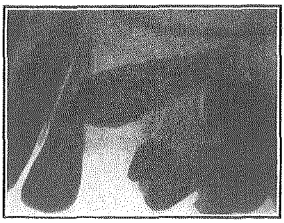


Fig. 693.—Unerupted upper cuspid.

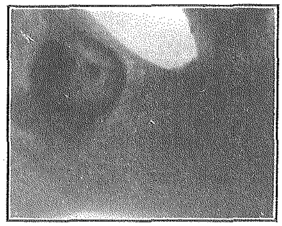


Fig. 694.—Unerupted and imbedded lower third molar in the mouth of a patient, aged sixty-five years, which gave rise to great suffering. The patient was almost insane from pain for a period of three years. Pressure on the inferior dental nerve together with a pulp exposure was the source of intense agony. Owing to the age of the patient, calcification was almost complete, making the surgical removal of this tooth extremely difficult. The patient made a good recovery after the operation.

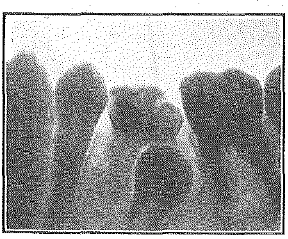


Fig. 695.—Erupting permanent bicuspid beneath crown of deciduous tooth.

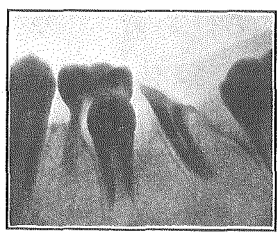


Fig. 696.—Interlocking of unerupted permanent bicuspid imbedded in crown of deciduous molar. Also root of permanent first molar.

Abscess.—The word "abscess" has surely become the bugbear of the dental profession, and to no specialist in dentistry has the presence of this enemy become more awe-inspiring than to the crown and bridge worker. If indicated by discoloration of the crown of the tooth, or by a draining fistula, the unsound state of a tooth and its bony support is plainly enough indicated; but what of the innumerable teeth with blind foci of infection, which give no evidence of their presence for years, and only after a more or less prolonged period of obscure activity manifest their noxious influence in a remote systemic condition? The utilization of such a tooth in crown and bridge-work naturally subjects the patient to untold

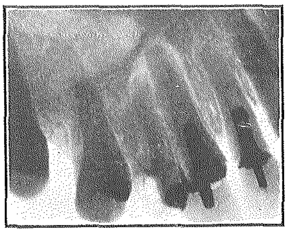


FIG. 697.—Alveolar abscess in lateral, cuspid, and first bicuspid.

FIG. 698.—Abscess of left lateral incisor, and imperfect root canal fillings.

FIG. 699.—Badly abscessed root of lower second bicuspid and incipient abscess of molar.

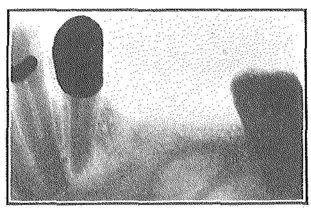


FIG. 700.—Abscess at apex of first bicuspid.

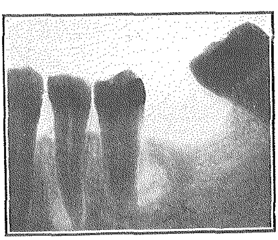


FIG. 701.—Abscess of lower first and second bicuspids.

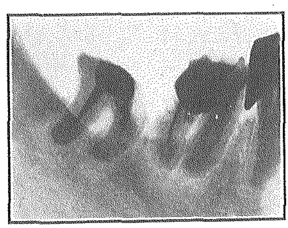


FIG. 702.—First and second molars badly abscessed and decayed roots indicating unfitness for crown or bridge-work.

risks, and the crown and bridge worker has practically no other, or at least no such convenient and reliable diagnostic agent at his command for the detection of these foci, as the *x*-ray. Hence it becomes his duty to ascertain the true condition of the teeth and their substructures not only in suspected cases, but practically in all cases where restoration is demanded, because none of these cases can any longer be considered normal. If precautions of this nature had been resorted to as soon as the *x*-ray became available, the crown and bridge worker could have spared himself the recent arraignment of the medical and dental professions at large, and could have avoided the jeopardy in which the very principles upon which his specialty is based have been temporarily placed. Even when an *x*-ray examination is made, the interpretation of the resulting röntgenogram is a matter of greatest importance, because the mistaken incrimination of a tooth is almost as serious an error in judgment, as is the overlooking and neglect of such a condition if present. Röntgenograms of abscessed conditions probably tax the skill in technic and interpretation of the radiologist to the severest degree, and only pictures of such quality as shown in Figs. 697 to 702, should be trusted as reliable diagnostic aids.

Root-canal Fillings.—While the determination of the vitality or non-vitality of a tooth, so easily accomplished by means of radiography, can be achieved by other diagnostic means, the utilization of the Röntgen ray in root-canal fillings before, during, and after this operation has become almost a *sine qua non* of dental operative practice. The crown and bridge worker, of course, is especially interested in the protection of roots which are to serve as supports for his work, and no matter whether he leaves the root filling operation to some other operator, or does it himself, he could not and would not dispense with the insurance of the perfection of root fillings, as is furnished to him by no other available means than the *x*-ray. Like obscure chronic dental abscesses, unfilled or imperfectly-filled root canals are a prolific source of systemic infection, in fact a large percentage of chronic blind abscesses are directly caused by imperfect root-canal work, the infection being set up by the hematogenous route. Various stages and conditions of root canal fillings are illustrated in Figs. 703 to 710.

Perforations (see Figs. 707 to 713), accidentally produced in efforts at enlarging or opening root canals especially in cases of extensive calcification or formation of secondary dentin, or the presence of foreign bodies such as fragments of broaches, reamers, burs, etc., in root canals or in the periapical space, cannot escape detection if the safety measure of *x*-ray examination is resorted to before instituting restorations, and the necessity of such timely detection will surely not be challenged by any operator.

FIG. 703.—Successful effort in opening two very small canals to the apex in upper second bicuspid.

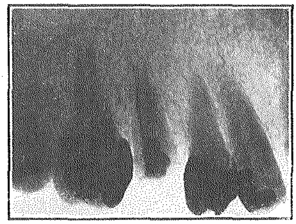


FIG. 704.—Successful filling of canals.

FIG. 705.—Imperfect root canal fillings, alveolar abscesses and root remaining in jaw.

FIG. 706.—Filling of root canals and accidental crowding of filling material through apex. This apparently was non-irritating and gave the patient no trouble.

FIG. 707.—Successful opening of calcified canals with wire inserted to apex. Also successful opening of pulp chamber giving a clear field of vision to canals so essential in successful root canal work. Mesial canal successfully filled.

FIG. 708.—Perfect root-canal filling and perforation.

Roots.—*Fractured Roots.*—Under the stress of mastication or as the result of trauma, the root of a tooth may have been fractured.

Usually the presence of such a fracture is readily detected by the patient, but for the operator it is of great value to determine the

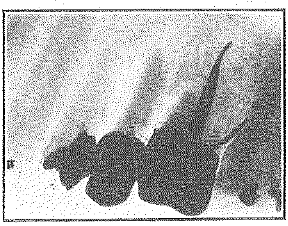


Fig. 709.—Overfilled and perforated roots, unfilled root, abscess and root absorption.

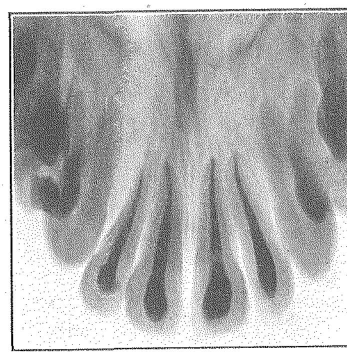


Fig. 710.—Three perfect, one imperfect root-canal fillings.

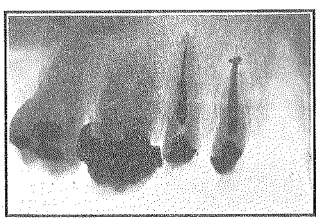


Fig. 711.—First molar showing perforated root with futile effort to fill canal. Wires inside second molar showing complete opening to apex.

Fig. 712.—Root perforation.

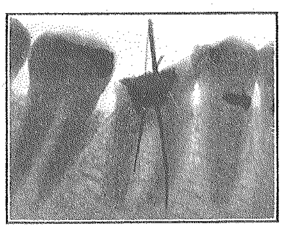


Fig. 713.—Shows broaches placed in perforations in floor of pulp chamber, mistaken for canals by the operator. These perforations were sealed after being located by broaches and tooth filled.

extent and nature of such a fracture, if he wishes to prevent the loss of the root which may be extremely valuable as an abutment (see Fig. 714).

Measuring Roots.—The length of the roots of teeth to be employed as abutments, especially if a post is to be inserted in the root canal, can be readily determined by a correctly-posed röntgenograph. An accurate knowledge of this important datum naturally greatly

Fig. 714. — Shows fractured root of central incisor, result of traumatism.

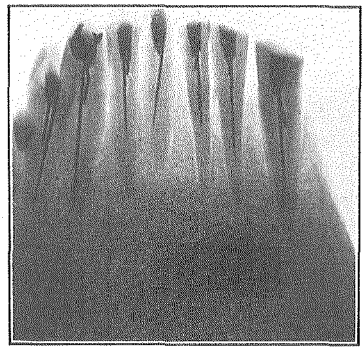


Fig. 715.—Demonstrating the plan of introducing wires in canals of lower teeth and the correct position for making exposure.

Fig. 716.—Abscess of lower centrals, the correct position and possibility of showing normal length of lower teeth, and lack of root-canal filling.

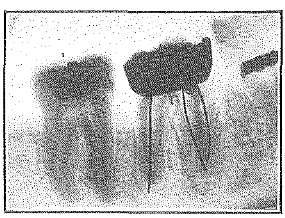


Fig. 717.—Wires inserted in root canals for measuring purposes.

Fig. 718.—Wire inserted in root canal for purposes of diagnosis.

facilitates the operator's task in determining not only the length of the post which he may insert, but also the limit of stress and strain which he may impose upon a particular abutment. The method of taking accurate measurement of the length of a root, by means of wires inserted therein, is illustrated in Figs. 715 to 718.

28

Anomalies in the Number of Roots.—Although he be thoroughly familiar with special dental anatomy, the crown and bridge worker may be uncertain as to the number of roots present in a particular tooth, since deviations from the normal number of roots are met with quite frequently. Failure to detect the presence of such an anomaly in a patient would naturally lead, sooner or later, to complications, the nature of which would remain obscure to the patient as well as the operator, were it not for radiographic evidence (see Figs. 719 and 720).

FIG. 719.—Lower double-rooted cuspid, showing the possibility of failure by following the usual rule of looking for one canal in anterior teeth. Such multiple canals are often seen by the radiographer.

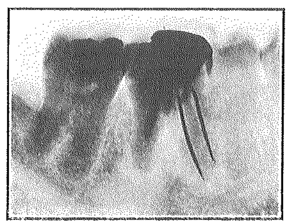


FIG. 720.—Lower first molar with three root canals.

Anomalies in the Shape and Direction of Roots.—Curved, crooked, constricted or flattened roots present special difficulties to the crown and bridge worker. The torsion of a root may even be so pronounced as to entirely preclude the possibility of successful root-canal filling, and it would be nothing short of folly to attempt the placement of a restoration upon such an unreliable foundation. The general direction of roots and their parallelism, so important in bridge restorations, is quickly determined by radiographs, as shown in Figs. 721 and 722.

Proximity of Roots to the Maxillary Sinus.—The proximity of roots to the maxillary sinus may be a factor in determining what amount of stress may be safely imposed upon an abutment. In case of protrusion of a root into the sinus itself, it is, of course, essential that the operator be aware of this fortunately rare condition, and be guided accordingly in his operative procedures (see Figs. 723 and 724). Disease of the maxillary sinus, if suspected, should be fully ascertained before any steps are taken toward crown or bridge restoration, since the pathological condition could only be seriously aggravated by untimely and ill-advised prosthetic interference.

FIG. 721.—Crooked root of lower second bicuspid demonstrating the impossibility of successful root filling. First molar shows enlarged tooth roots with calcified canals.

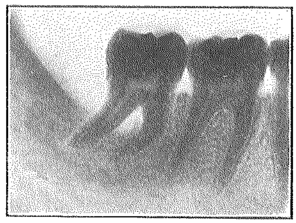


FIG. 722.—Crooked roots of a lower second molar with alveolar border destroyed by pyorrhea.

Root Fragments Left in the Mouth.—It goes without saying that the presence of a root fragment left in the alveolar process (see Figs. 725 and 726) would seriously jeopard the usefulness and service of a bridge, since an acute infection may at any time be set up around such a fragment as a nucleus. The *x*-ray readily reveals the presence of any such fragments, and their extraction

FIG. 723.—Six teeth on small film and position for making exposure. Alveolar abscess and unfilled canal of second bicuspid. Large area above molars shows dipping down of lower border of *maxillary sinus*, but does not indicate any special pathological condition.

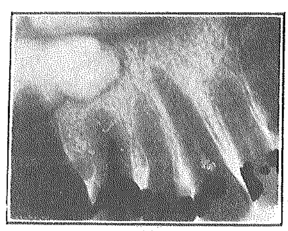


FIG. 724.—Upper teeth, abscesses and unfilled canals, rarefied area extending from lateral to first molar. The light area extending over bicuspid and molar is the anterior border of the maxillary sinus.

becomes a matter of course before attempting prosthesis, since the removal of deeply imbedded root fragments from under a bridge offers unnecessary complications, and might result in the destruction of the bridge by the exodontist.

Pyorrhea Alveolaris.—Next to dental caries, the disease, or rather, the complex of diseases called pyorrhea alveolaris calls

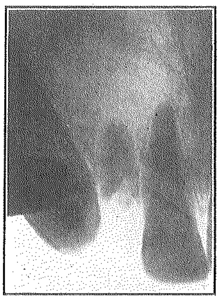


FIG. 725.—Lateral root that remained in the mouth ten years after effort at extraction.

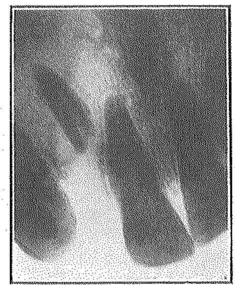


FIG. 726.—Later effort which resulted in pushing the root in the alveolar region at the floor of the nose.

FIG. 727.—Portion of first bicuspid apex located in necrotic area in immediate proximity to the wall of the maxillary sinus.

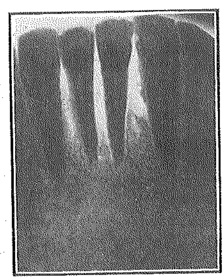


FIG. 728.—Pyorrheal teeth and normal position for making radiograph of lower incisors.

FIG. 729.—Pyorrheal teeth, and complete destruction of alveolar support.

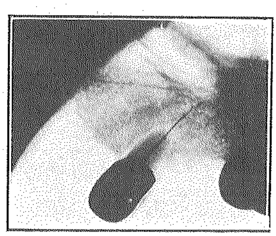


FIG. 730.—Ill-fitting crown placed over tooth with broken broach left in root canal.

most frequently for prosthetic restoration of the masticating organs. After thorough surgical curetment and therapeutic and dietetic measures have been instituted by the pyorrhea specialist, the crown and bridge worker may be called upon to afford the patient's teeth surgical rest in the form of immobilization by means of a temporary splint. As soon as consolidation of the affected teeth has taken place, his plans naturally turn to permanent restoration, the practicability of which is again determined by the radiographic findings. It would be folly to base any reconstructional work upon weak and unreliable abutments which are supported by but a doubtfully strong, worse by an almost completely destroyed alveolus, as shown in Figs. 728 and 729. The radiograph will be the final criterion as to the retention or elimination of doubtful links in the chain of abutments; it will militate against unwise hyperconservatism, and safeguard an honest prognosis.

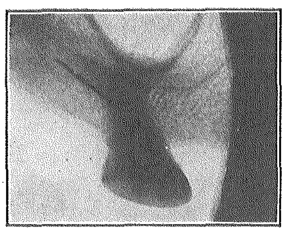


FIG. 731.—Steel needle broken during tuberosity injection.

Foreign Bodies.—Fortunately, the presence of foreign bodies in the maxillæ usually manifests itself by a violent reaction; yet in persons of low vitality whose defensive force is greatly reduced, a foreign body may be tolerated by the tissues for a surprisingly prolonged period of time. Broken broaches, probes, burs, reamers, drills, etc., may remain in root canals without signaling their presence by inflammatory reaction, and the placement of a crown over such a tooth may cast a serious reflexion upon the crown and bridge worker's circumspection (see Fig. 730). An excessive amount of gutta-percha or resin may have been forced through the apical foramen into the periapical space in an attempt to fill a root canal to the end, and though it may be lying dormant for awhile, it will surely sometime sooner or later manifest its presence by a violent inflammation. Here again, the *x*-ray discloses the location and amount of foreign material and guides the surgeon's hands in its removal by way of alveolotomy.

As conductive anesthesia is daily growing in popularity, and since the use of steel needles, despite numerous contra-indications, is still being persisted in by many operators, the number of instances in which needles are fractured within the tissues is bound to increase. If sterile, these needles may cause no disturbance whatever for some time, yet any decrease in the resistance of the area in question may lead to complications which may prove fatal to the crown and bridge worker's achievement. Radiographic search, therefore, for fractured steel needles is indicated whenever there is the slightest suspicion of such an accident having occurred, and the fragment is to be removed by surgical intervention. A case of this description is illustrated in Fig. 731.

ILL-FITTING CROWNS AND BRIDGES AND THEIR SEQUELÆ.

After what has already been said about the untoward sequelæ of ill-fitting crowns and bridges, it seems hardly necessary to emphasize once more the multiple dangers that may lurk in poorly constructed work for the preservation of the abutment units as well as the oral and general health of the patient. Since the question has been seriously asked: "Is crown and bridge-work a menace?", it behooves the specialist to justify his answer: "Not, if constructed with due consideration of the principles of mechanics, anatomy, physiology and pathology of the units involved," by a judicious and liberal application of all the means available for the preclusion of failure, and toward this end, the *x*-ray has surely proved itself to be an indispensable adjuvant. The illustrations presented in Figs. 732 to 737 are shocking negative examples of bridge-work, and their correct interpretation and explanation to the patient will in many cases result in the patient's realization of the necessity of the elimination of the pathologic conditions present and in his consent to a reconstruction of the prosthetic work upon truly scientific principles after removal of the old menace and restoration of the tissues to full health. A series of radiographs encompassing the full upper and lower arches will afford the best survey over the condition of a mouth. A striking example of this sort is furnished in Figs. 738 to 745. The patient, a well-known physician and writer on general and, since the revelation of his own deplorable dental condition, oral prophylaxis, claimed to have a perfectly "comfortable" mouth, while systemically he was suffering with rheumatoid arthritis associated with septic endocarditis. A radiographic examination of his mouth revealed the following conditions:

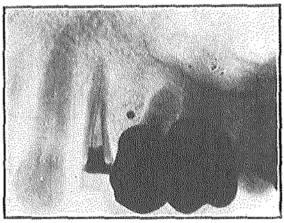


Fig. 732.—Ill-fitting bicuspid crown, hypercementosed root, and alveolar abscess.

Fig. 733.—Lower first molar, with both roots abscessed. Anterior root bathed in pus. Extensive destruction of process. Posterior root shows caries under crown.

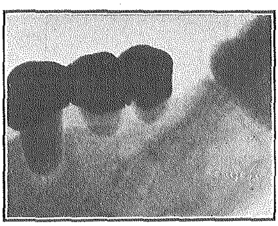


Fig. 734. — Alveolar abscess. Two overhanging dummies on bridge. Ill-fitting crown on bicuspid.

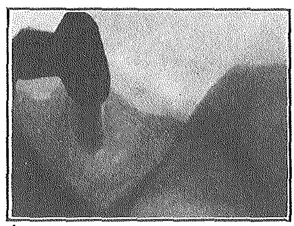


Fig. 735.—Large abscess sack at root of bicuspid under bridge, and ill-fitting crown.

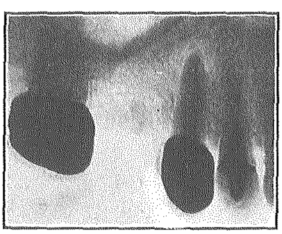


Fig. 736.—Bicuspid with apical abscess and ill-fitting bicuspid and molar crowns.

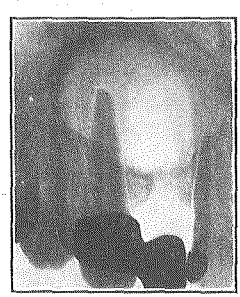


Fig. 737.—Large abscess area produced by death of pulp under ill-fitting bicuspid crown.

Fig. 738: Caries beneath filling; alveolar abscess draining into interdental space; absence of root canal fillings in first, second, and third molars.

Fig. 739: Imperfect root-canal fillings in bicuspid and cuspid, with calcification of unfilled portions; poorly fitting band.

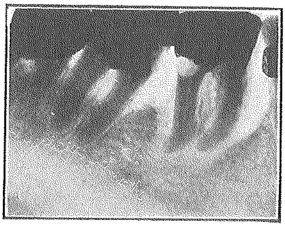


Fig. 738

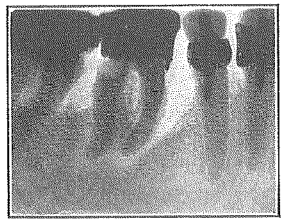


Fig. 739

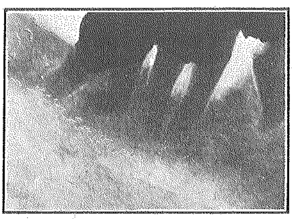


Fig. 740

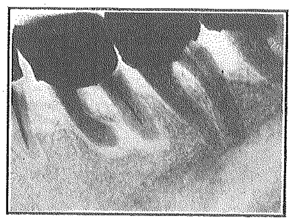


Fig. 741

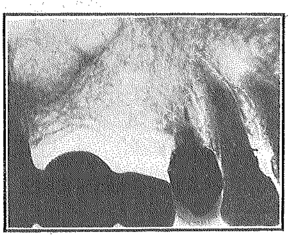


Fig. 742

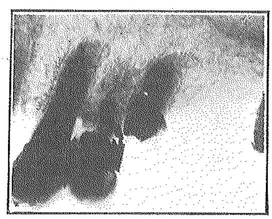


Fig. 743

Fig. 744

Fig. 745

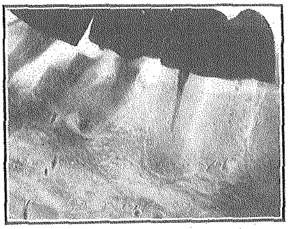


FIG. 746

FIG. 747

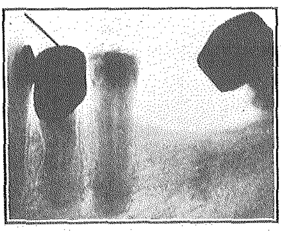


FIG. 748

FIG. 749

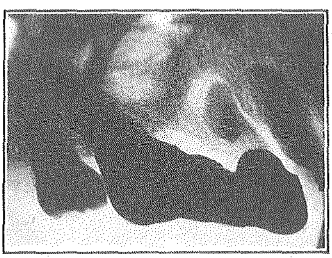


FIG. 750

FIG. 751

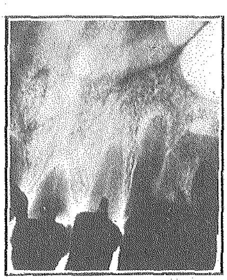


FIG. 752

Fig. 740: Crooked third molar roots.

Fig. 741: Similar conditions as in Figs. 738 to 740.

Figs. 742 to 745: General septic and rarefied areas involving apices of roots; syndrome of untoward mechanical and pathologic conditions.

Thorough corrective treatment, beginning with the removal of the "septic" crown and bridge-work, restitution of the tissues to health, correct root-canal fillings and correctly constructed crown and bridge-work restored the patient to health, the systemic symptoms subsiding with the removal of the oral sepsis.

Another interesting example of a supposedly healthy mouth is illustrated in Figs. 746 to 752. This patient was of normal appearance and weight, and claimed health with the exception of rheumatism and slight diabetes. All efforts to locate the seat of this trouble proved negative, until the mouth was examined. For the sake of practice, the interpretation of this radiographic series is left to the reader. In this case, the forceps seem to be indicated as the best therapeutic agent for the restoration of the patient's health.

Conclusion.—In conclusion, it may not be amiss to point out the usefulness of which, from a medico-legal aspect, may be the x-ray in substantiating or disproving charges of malpractice brought against the crown and bridge worker; for it is by this means that the success of attempts at palliative treatment prior to insertion of bridge-work, and the accuracy of bands, the parallelity of posts, the perfection of root-canal fillings, in short almost all the factors that constitute scientific bridge-work can be demonstrated *ad oculos*. In teaching crown and bridge also, the radiograph is an instructive and convincing aid in demonstrating poor versus good bridge-work.

In fine, dentistry more than any other profession has, despite the remarkably short period of time in which it has evolved from a trade into an art and science, availed itself of every innovation in the fields of technic and science in its arduous strife toward perfection. It therefore behooves the specialist in crown and bridge-work, who is called upon to make the most skilful restorations known in the realm of prosthesis, to avail himself to the fullest extent of William Konrad Röntgen's discovery.

INDEX.

B

D

M

N

O

P

U

W

X

Z