SOME METHODS AND APPLIANCES IN OPERATIVE AND MECHANICAL DENTISTRY

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By R. P. LENNOX.

WITH ILLUSTRATIONS.

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PREFACE.

THE primary object of this little book is twofold. On the one hand, an attempt has been made to reply once for all to questions put to the author from time to time with regard to papers he has read before the British Dental Association and its Branches. On the other, it has been sought to render more readily accessible and useful so much of those papers as appears fairly to have stood the test of experience.

Advantage has also been taken of the opportunity afforded by the carrying out of these purposes to add a few hints on matters not to be found in the text-books, and further to give an account of those of the author's methods of working which differ from the methods generally to be found there. In doing this, the author has been far from wishing to insist upon his own methods as the better. Long use may well have made even difficult and troublesome operations easy. At the same time, it is felt that methods which are the outcome of forty years' experience can hardly be without interest for others, and beginners will no doubt be glad to have some latitude of choice presented to them.

If the author has also ventured to add a few criticisms of other methods, it is hoped that this has been done in no spirit of egotism, but simply with a wish to forward the discussion of moot points and to enable readers to arrive at a decision upon them.

CAMBRIDGE,
April, 1897.

CONTENTS.

CHAPTER I.

SOME METHODS IN PRACTICE.

UNDER this heading, I propose to give an account of such of my methods of working as differ in any way, at all likely to be of interest to others, from the methods described in the text-books, and to add a few opinions in passing for what they may be worth.

It will conduce to clearness to take the several operations, as nearly as may be, in the order in which they present themselves in actual work.

Taking an impression. Many people insist strongly that in taking an impression the best results are not to be had except by the use of plaster. But everything depends upon the purpose for which the impression is to be used. If for any purpose a model is desired which shall show the soft tissues absolutely undisplaced, then undoubtedly plaster affords the best, if not the only, means of obtaining it, and all the annoyance and trouble for patient and operator which attend the use of plaster must be endured. But to attempt to make a plate from such a model would be to court failure. The plate would ride upon the harder parts of the mouth and, displacing the soft tissues on the side under pressure, would cease to touch at all on the other. If an attempt is made to correct this by relieving the pressure on the harder parts of the mouth, then all the soft tissues will be more or less displaced under pressure, and the plate is called upon to fit a surface which the model does not give.

On the other hand, when an impression is taken with composition, the operation is as little disagreeable to the patient as such an operation can be, the pressure of the composition displaces the soft tissues just as the plate will afterwards displace them, the impression obtained with any good composition is as sharply defined as any plaster impression, and the resulting plate sits firmly at all points.

It may further be pointed out that it is no objection to the use of composition in taking impressions that it does not give the frenum and similar folds of the mucous membrane in their normal positions, since it will show their points of attachment quite distinctly, and it is from these no less than from the folds themselves that the plate has to be kept clear. This is, of course, done by well rounding and turning up the edges of the plate away from the folds at all points, an effect secured in the case of a gold-plate by filling up the parts of the model, where relief is required, with wax, before casting the zinc.

Again, the time required for composition to set may be made very short as compared with that required for plaster. After packing the composition into the tray in the usual way, I soften the surface by pouring on boiling water from a kettle. This is preferable to warming over a spirit-lamp, because there is less risk of overheating the composition and burning the patient's mouth. Then, just before inserting the tray into the mouth, I cool the outside with a spongeful of cold water. The parts of the composition in contact with the tray are thus partially set and help to force the still soft parts into position, while the time required for the whole to set is much reduced. Finally, when the tray is in position, I spray it with cold water from an 8 oz. syringe (Fig. 1) with a nozzle bent at right angles, a basin being held close under the patient's chin to catch the overflow of water. In this way the setting of the composition, which otherwise takes four or five minutes, is effected in about a minute, and the water, in general,

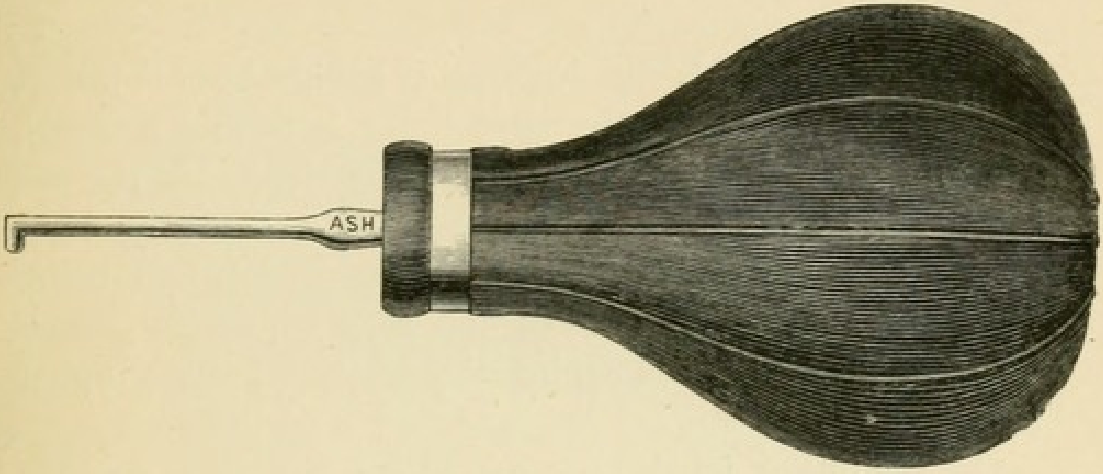


Fig. 1.

proves grateful rather than not to a mouth overheated by a mass of warm composition. Irrigated trays have been devised to effect the purpose thus attained, but the trays are cumbersome, and more difficult to insert than ordinary trays, themselves not seldom difficult enough.

While on the subject of trays, I may say that I have hardly ever found it necessary to make a special tray, a very little ingenuity sufficing to make the ordinary trays serve every purpose.

Later on (page 78) is given a description of a tray (Fig. 2)

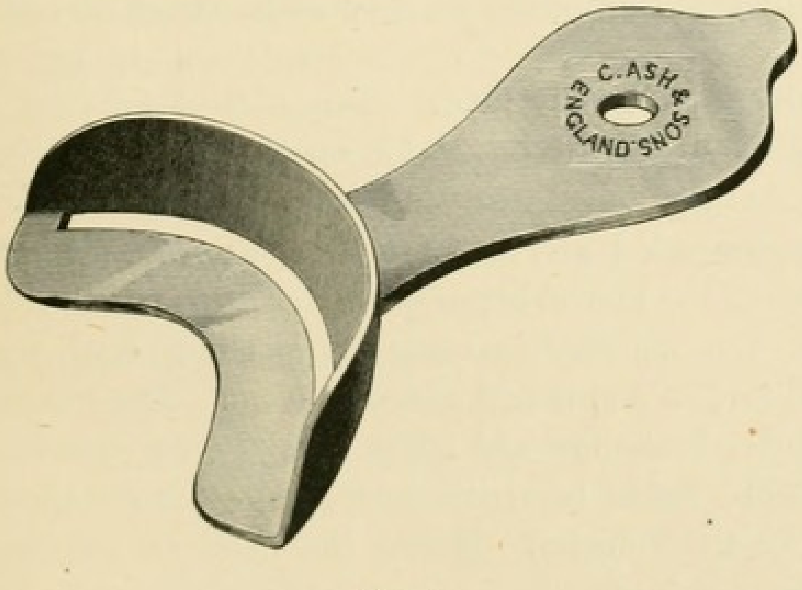


Fig. 2.

for taking an impression of the root-faces, and for determining the directions and the depths of the root-canals, of the six anterior teeth.

Casting a model. An impression having been obtained in one way or another, the next thing is to cast a model, as to which I wish merely to say that I deprecate the use of wires to strengthen the teeth, as they necessarily stand out above the teeth and so prevent the models from being brought into correct occlusion, and they cannot be ground away without risk of damaging the teeth, especially upper bicuspids.

On the other hand, in cases where, say in a lower, a molar on either side of the model leans forward so that it would be difficult or impossible to remove a properly-fitting composition plate, I drill a hole along the axis of the inclined tooth; fit a wire into the hole; remove the wire again; break the tooth, smartly, short off; cut or file the wire to the exact length of the tooth, and replace the wire in the model. As the wire was fitted to the tooth, the tooth can be replaced and held accurately in position; and can be removed, when the moment for removing the composition plate arrives.

Models should be dipped in stearine, and pink wax should be used in making them up for casting, as it can be readily removed, when its purpose has been served.

Making a gold-plate. Numberless are the devices discussed by the text-books for securing a well-fitting gold-plate. As many as three zinc dies and three lead counters are recommended, and are, no doubt, often necessary in consequence of the methods pursued.

The first counter is made by pouring lead upon the exposed face of a zinc embedded in sand. The result is that the counter is shallow and offers no guide for the die, which is therefore liable to strike awry, and so to obliterate the details in the counter. Hence the need for two and even for three counters.

My plan is to wrap a roll of clay around the only zinc I use (Fig. 3), and dip the latter far enough into the ladle of molten lead to cover the clay. The effect of this (Fig. 4) is to give all that is aimed at in the shallow counter, without

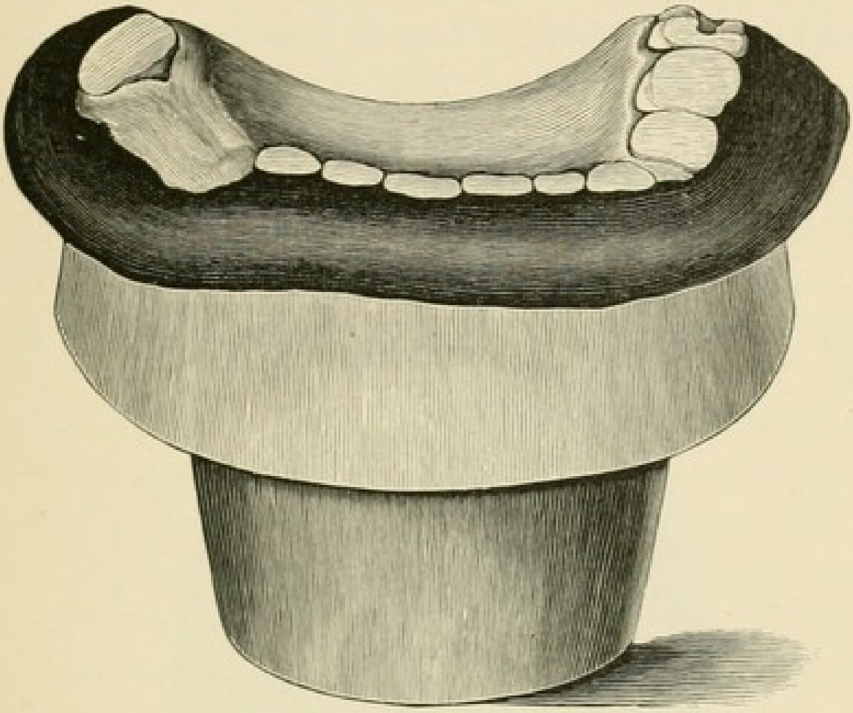


Fig. 3.

sacrificing the strength and the guide afforded by a deep counter.

Accuracy in directing the blows and distributing the force of them is also gained by the use of a Pearsall sand-moulding flask, the advantages of which seem surprisingly long in gaining recognition. When this flask is used in casting a zinc die, a strong cone (Fig. 3) is formed at the back of the die, from which these advantages follow. The plaster model need not be more than one inch deep at the heel, the zinc can be readily grasped in a vice and otherwise readily handled, and it never cracks under the hammer. With this die and a counter made as above described, perfect accuracy in directing the blows is obtained, and the life of the counter is much prolonged, so much so that I find one zinc die, one lead and one tin counter sufficient for all purposes. My ladle for the counters is hemispherical, and I always swage in my hand, the roundness of the outside of the counter rendering this easy. My hammer weighs $2\frac{1}{4}$ lbs. One result of this method of swaging is that the lead counter is not spread to anything like the same extent as when the swaging is done on a block.

In preparing a plate for swaging, I do not use a lead pattern, but cut a rough pattern in paper rather larger than

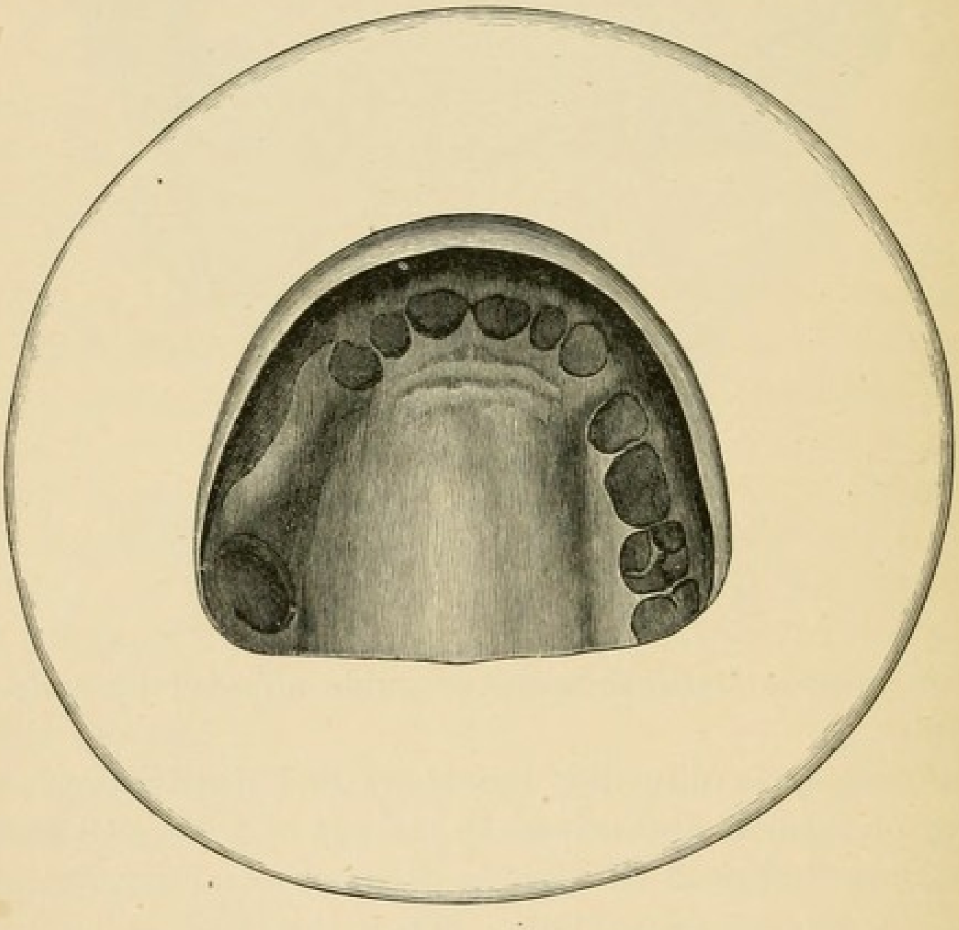


Fig. 4.

the required plate, the use of the clay as above described rendering this possible without difficulty. Time and trouble in the preliminary adjustment of the plate are thus saved.

I may add that I have entirely given up the use of suction chambers and all kindred devices, whether in gold or in vulcanite work; they are at all times harmful, and ultimately, by filling themselves with the soft tissues, become inoperative, the better made the chamber the worse the result.

Making a base or trying-in plate for vulcanite work. Three things are essential to a satisfactory trying-in plate. It should be rigid, close-fitting, and quickly made. It is unnecessary to discuss here how far any of the many ways described in the text-books for making such plates gives a plate possessing these characteristics. It is enough to say that in my own practice I use modelling composition for lower plates and fusible metal for uppers. The method of making a fusible metal plate will be found on a later page (p. 55). It is very simple, and any one who will try it will be able to satisfy himself in a very few minutes that the plate obtained has all the qualities enumerated above.

Taking a bite. With such a plate we may proceed to take the bite with confidence and at our leisure, and those who use a wax or gutta-percha plate for the purpose, especially if they make dummy bites, will appreciate what that means. But a dummy bite is another of those things which I have not yet learnt to use. It seems that it requires much carving and shaping to give a really good result, and after all it affords no indication of what the teeth will look like ultimately. My plan is to set up temporarily, on a composition plate, all the teeth in the lower jaw; and, on a fusible metal plate, the six anterior teeth in the upper jaw. In the remaining spaces I adjust blocks of soft wax, and proceed to take the bite. As the metal plate keeps up even better than a finished plate, and the teeth are readily readjusted on it, if need be—though in general careful observation of what is wanted is sufficient—the work of obtaining a bite in this way is attended with as little trouble and difficulty as possible, and the marks made by the bicuspids and molars of the lower jaw in the soft wax blocks of the upper suffice to determine the articulation when the plates are removed from the mouth. It seems clear that on this plan, in which the actual teeth to be ultimately used may be employed, we have a readier means of determining what sort of teeth and what setting of them will be suitable in any given case than any mere dummy bite can afford.

Articulators. There is, perhaps, hardly any other article in the dental workshop over which so much ingenuity has been expended with so little attendant advantage as over articulators. What inventors have aimed at in many of their elaborate devices it would be hard to say. No articulator, be its capabilities as regards movement what they may, can make up for an incorrect bite. If, however, it were possible for any articulator to simulate, even approximately, the movements of each individual jaw that presents itself for treatment, some advantage would, no doubt, be gained by the possibility of seeing that the cusps of the teeth when set up moved over each other in the act of mastication in a way suited to the particular jaw in hand, but it is impossible to attain such movements in an articulator, and the value of any other movements is insignificant. We must resign ourselves to the necessity of testing the suitability of any given setting of the teeth by actual trial in the mouth for which they are intended. But if the advantages of these complicated devices are hard to find, their disadvantages are obvious, for they are cumbersome to handle, both models having to be handled together throughout the working, and they do not afford an unobstructed view of the interior of the mouth.

The essentials of a good articulator, at any rate such as are readily obtainable, are general ease of handling, accuracy and ease in the return of the models to proper occlusion after handling, and a ready view of the inner cusps of the teeth. All these are in my judgment most readily attained by means of the simple slab bite with an orifice through it for viewing the interior of the mouth. For this reason I always found the old plaster slab a very effective articulator, but a fusible metal slab has advantages over even a plaster slab, and these together with the method of making a fusible metal slab will be found described on page 57.

Setting up teeth. There is but one point in connection with setting up teeth to which I wish to refer, and that is the not uncommon fault of unduly contracting the arch of the teeth of the upper jaw. This contraction is sometimes advocated in order to make room for springs when these cannot be dispensed with, but more generally it appears to be due to an idea that it is absolutely essential to place the teeth upon what remains of the alveolar ridge. In my view neither of these reasons can be justified, and I make it my practice to keep the arch as wide as possible.

Springs. In the majority of cases, well-made plates need no special contrivance to keep them in position. Where any contrivance at all is necessary, I prefer to use springs. These are, in general, only necessary where a lower is difficult to keep in position, and even in such cases the use of them may sometimes be avoided by weighting the lower with Watt's or other metal. On the other hand, it sometimes happens that, in the case of very aged patients, the alveolar border is so far absorbed that even springs do not avail to keep the lower in place, and some additional contrivance becomes necessary.

When springs are to be inserted, a question arises upon which authorities appear to differ, viz. as to the position of the bolts. If these are placed too far back, the springs must either be too short, or themselves go back too far and gall the mucous membrane. My rule is never to place the bolts in the lower further back than just below the centre of the second bicuspid, while in general I place them more forward, the room in the mouth, of course, determining the position in any given case. The bolts in the upper should go vertically over those in the lower, or rather just the least bit backward of that position.

Whenever possible, I avoid vulcanising the bolts themselves into the positions intended for them, replacing them temporarily by pieces of knitting-needle (Fig. 7) taken back to a blue. These are afterwards readily withdrawn by heating the ends with a blow-pipe and using a strong pair of pliers. They are then replaced by the bolts, which should fit tightly into the holes prepared for them. The advantage of this method is that, when the swivels are worn out, the bolts can be easily removed and the swivels renewed. Figure 7 shows a piece of knitting-needle applied in a partial case where, of course, it would not be wanted, but this was done to save time and labour at a moment when either could ill be spared.

To support the spring and keep it from injuring the mucous membrane, the text-books recommend a ledge of vulcanite on the lower set; some appear to recommend one also on the upper. The ledge on the upper is, in my opinion, worse than superfluous. In the lower to effect the same purpose as the vulcanite rest and avoid friction on the spring, I drill, whenever possible, a small hole just under the stem of the swivel, close to the eye, and insert a piece of tapped wire.

In cases where, owing to the absorption of the alveolar process, some contrivance in addition to springs is necessary, the simple one shown in Fig. 5 has been proved effective by a patient, now (1897) 96 years of age, who has worn a set, so equipped, with comfort for seven years. This patient had worn a set of teeth with springs for about twenty years, when, owing to the absorption of the alveolar process and to other changes due to advanced age, the lower plate used to slip forward, and was only retained in the mouth by the pressure of the lower lip, which was thus made to protrude. In the first instance, it was hoped that a remedy would be found by simply making a new set on the same plan as before, but adapted to the new form of the mouth. This proving of no avail, a suction upper and a lower weighted with Watt's metal were tried. These the patient said she got on well with 'so long as she sat bolt upright.' In other positions, the lower slipped forward as before, and she had the additional discomfort of feeling the upper drop a little. In these circumstances, the device shown in Fig. 5 was adopted with the result already described, both the slipping forward of the lower and the dropping of the upper being got rid of. It was at first feared that new difficulties might have been introduced in the mastication of food and the clearing of it from the additional mechanism, but no such trouble has arisen. The contrivance, perhaps, hardly calls for any description beyond what Figure 5 affords. The second

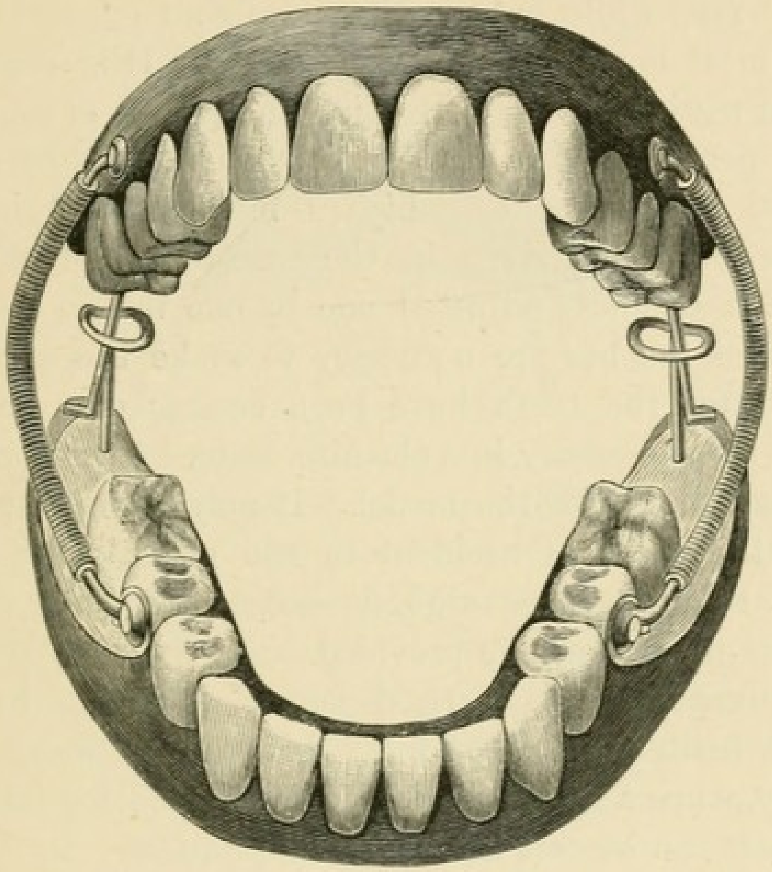


Fig. 5.

molars being omitted from both plates, a post with its foot as far back as possible on the lower plate leans forward and carries at the top a loop or ring which just clears the upper plate when the mouth is closed. A post, fixed upright in the upper and just long enough to clear the lower plate in the closed position of the mouth, is so placed as to pass through the loop on the top of the lower post and to press against the loop upon any attempt of the lower to slip forward. A bend at the lower end of the upper post serves to prevent this post from drawing clear of the loop, if at any time the mouth should chance to be opened to an unusual extent.

This device enabled me to get over what threatened to be a very troublesome case.

Flasking. When we come to flasking, the first question that arises is:—Shall the original model be used to vulcanise upon and so be lost? Most people, it appears, would answer 'Yes,' while my practice is—in all edentulous cases and in most lowers—to save the model. It is useful afterwards in testing for and correcting the results of contraction, and in perfecting the articulation, without that repeated reference to the mouth which I make it a principle of practice to avoid. Even in the case of tube-teeth, which have been carefully adjusted one by one in the articulator, a few final touches are necessary to make the articulation perfect after the teeth have been cemented on, and they are not less necessary in vulcanite cases. Therefore, whenever possible, I save the model. It may even come in later still in the event of accident to the plate. But, if it be decided to keep the original model, a second model to vulcanise upon must be provided.

Fortunately, with a rigid and close-fitting base-plate such as fusible metal affords, this can be done without difficulty, since a second model quite as good for its purpose as the first can be cast into the base-plate.

The method of proceeding is as follows:—Let us suppose in the first instance that we are dealing with an edentulous case. The case being ready for flasking, I fill in the spaces between the teeth and any other hollows or recesses, such as the palate, in which air would be likely to be imprisoned, with plaster applied with the point of a knife; and then invest the plate, teeth downwards, in the deeper part of the flask previously filled with plaster. The plate being embedded up to its edge, the plaster between the edge of the plate and the flask is trimmed level and, when set, is lightly brushed with vaseline, the plate itself being treated in the same way and afterwards wiped as nearly clean as possible. More plaster is now put in, a little at a time, and carefully shaken down by a few smart raps upon the bench, so that no air spaces may be left. The other part of the flask is filled with plaster, and the flask, being closed, is laid aside with a weight upon it for the plaster to set.

When this has taken place, the flask is heated over a Fletcher's burner (Fig. 6) and the two parts are separated.

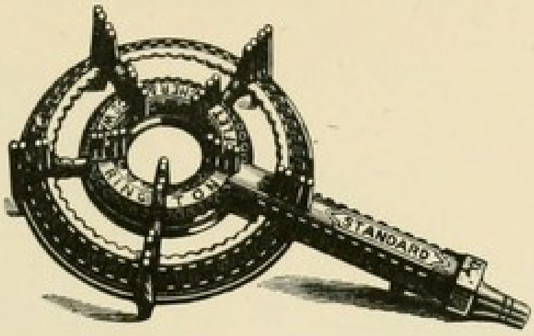


FIG. 6.

The shallower part now contains the second model at which we have been aiming. I should add that I prefer to separate the parts of the flask by heating over a Fletcher's burner rather than by boiling, because in this way no water gets at the second model.

The wax is next carefully picked and scalded out of the deeper part of the flask, and the plate is removed from the model. If of fusible metal, it is divided, for ease of removal, into two or more parts by means of a warm iron rod, and the case is ready for packing.

If the case is a partial one, some simple devices are necessary to keep the plaster from invading the plate between the artificial teeth, in the process of investing, and to prevent bands and wires from being disturbed, in the process of packing.

To keep the plaster away from the impressions of the necks of the natural teeth, as soon as the plate is ready for investing and is finally removed from the first model, I attach thin laminae of wax to the lingual surface of the plate, just at the edge, so as to project over the spaces between the artificial teeth (Fig. 7). When the case is invested, the plaster partially overflows these laminae, but does not reach the impressions of the necks of the natural teeth, and is readily cut away without damage to those impressions. Of course these laminae are reproduced in vulcanite, but, being very thin, they are readily removed, and add little to the trouble of cutting up. If a natural tooth is to be banded, no lamina is placed over the corre-

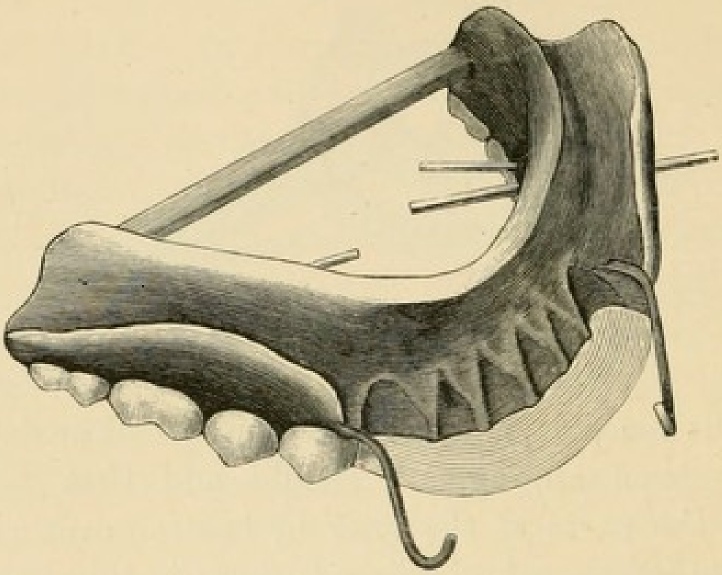


Fig. 7.

sponding space in the plate, because the plaster by flowing into the band secures it in position and prevents it from being disturbed in the process of packing.

If in a bar-lower a wire strengthener is to be inserted, I take a piece of wire some half-inch or more longer than the strengthener required, and bend the excess at either end at right angles, so that the ends of the wire may project into the mouth (Fig. 7) and be caught in the plaster, when invested, thus securing the strengthener in position during the packing.

When a tooth, say a canine, is to be wired rather than banded, I secure the wire in position in the flask by making it long enough, after going round the tooth, to be bent up and rise above the cutting edge of the tooth, with a slight hook at the end (Fig. 7). In the process of investing, this hook is caught in the plaster, and the wire is secured against disturbance.

Lastly, to prevent contraction in a lower plate, I cut a piece of match-stalk to a suitable length and wax it in between the heels of the plate (Fig. 7) before investing it.

This acts as a stay-bar, effectually preventing the contraction of the plate in the cold soft plaster, and it is easily removed when the case has cooled after vulcanising.

Brunton Two-Part Contour Flask. In partial cases where it may be necessary to vulcanise on the original model, as in cases where the teeth are ground to the model so as to appear eventually to grow out of the gum, I know of no flask which offers the same advantages as the Brunton Two-Part Contour Flask (Fig. 8). The illustration shows it

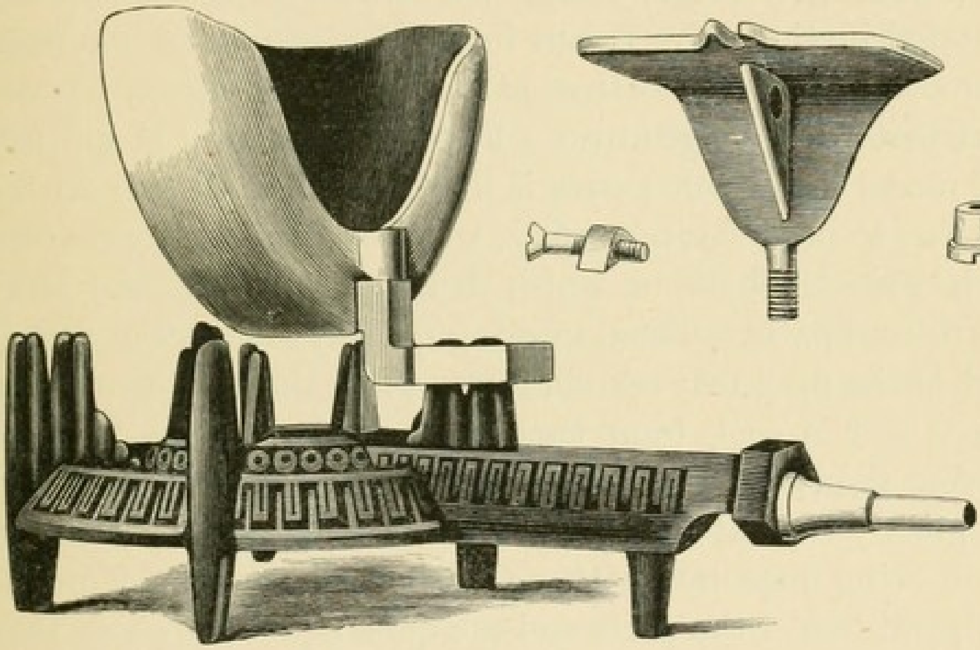


Fig. 8.

supported by a special arrangement over a Fletcher's Burner. The body of this flask is so shaped as to overhang the crowns or cutting-edges of the teeth, and this makes it impossible for the teeth to lift from the model in the process of packing, as the flask prevents the plaster from breaking.

Adding a tooth or teeth to a vulcanite case without casting a model. The method of flasking above described, whereby the original model is saved, also enables a model to be dispensed with altogether in the particular case where a tooth or teeth are to be added to a vulcanite case.

A dove-tail having been prepared in the usual way and some melted wax having been dropped on to the edges and flowed over the neighbouring parts of the vulcanite, the dove-tail is filled with wax and, the case being placed in the mouth, the wax is carefully modelled to the gum. The case is then carefully removed from the mouth, the teeth are waxed into position, the case is once again tried in the mouth, and is then finally invested in the flask in the manner before described (p. 12).

Packing. Teeth, bands, and wires being all securely invested by the above means in the deeper part of the flask, I proceed to pack into that part. Before doing so, I warm that part by placing it over a Fletcher's burner. Meanwhile the model in the other part is lightly rubbed all over with a soft rag to improve its surface, which is then lightly covered with French chalk, a brush being applied to the more corrugated parts. Then, working quickly so that the deeper part of the flask may remain warm while the part containing the model is cool, from time to time during the packing I bring the two parts quickly together in a press or vice and as quickly separate them, the rag usually placed between them being dispensed with. Owing to the difference in the temperatures of the parts and the quickness with which they are brought together and separated, there is no adhesion of the rubber to the model, and I am able in this way to see where there is any excess or deficiency in the rubber and to make it good, with great readiness and without any of the boiling out which some find necessary after every closing of the flask. The progress of the packing being thus readily inspected, I am able to avoid excess of rubber and consequently need no gateways for its escape.

Vulcanising. With a Gartell's gauge to regulate the supply of gas and a clock to turn it off at the fitting moment, the anxiety which used to attend the process of vulcanising has vanished. One consequence has been that I have sometimes been tempted to start vulcanising a case just before leaving work for the night, but I have found unfortunately that a case left to cool all night in the vulcaniser is much more difficult to clear of plaster than one attacked as soon as it is possible to handle it. Hydrochloric acid and water will indeed help to remove the plaster, but I should not recommend anyone, who is expecting to see a patient, to try it.

A hint which I gained very opportunely some years ago, from Mr W. Fawssett of Cambridge, with regard to vulcanising on a gold base may be given here, on the chance that it will be as useful to some as it was to me. It is that the tendency which the vulcanite has to curl slightly away from the gold plate may be overcome by carefully polishing, and rouging, and keeping free from grease, that part of the plate with which the vulcanite will come in contact.

With regard to the position of the flask in the vulcaniser, I have an idea that the teeth are less likely to change their positions in relation to the plate, if the deeper part of the flask is placed downwards in the vulcaniser.

Lastly, as to the vulcaniser itself, I would add that a lead washer, which is easily prepared from a piece of lead wire, will last for years, if only due care be taken, in screwing up the vulcaniser, always to bring together the same two points which have once been found suitable.

Tube-teeth on a vulcanite base. By way of transition from vulcanite work to gold work, I may here explain a method I sometimes adopt of using tube-teeth with a vulcanite base. A fusible metal plate being prepared as before (p. 55), I fix it on the model with wax; fill up with wax any inequalities in the ridge, so that the teeth required may be all of one length; and cast a model in zinc. With this zinc a gold strip of a width just sufficient to carry the teeth is struck up to fit the ridge. To this plate tube-teeth are fitted in the ordinary way, and, the teeth being in position on the pins, the case is so waxed up that, when it is vulcanised, the gold plate is covered by the vulcanite, but the teeth will with a little humouring readily leave the pins.

This method of making uppers allows of a ready renewal of the plate in cases where the mouth alters through the absorption of the alveolar process and well repays the extra trouble expended at the outset. The teeth have an individuality which they lack in an entirely vulcanite set, and may have all the interstices of natural teeth. They are also stronger than vulcanite teeth, especially in the molar region, while, should a tooth be fractured now and again, it can be replaced without the repeated vulcanising which is so destructive to a vulcanite plate. Moreover, when a new base is required, the teeth being already set up and correctly articulated, the labour of adapting a new base to them is small.

Shallow Bites. Sometimes a bite is so exceptionally close that, instead of using porcelain teeth for the molars, whether in gold plate or in vulcanite work, it is advantageous to use shallow gold crowns. In such a case a very natural and effective masticating surface is obtained by striking up these crowns with dies made of natural teeth (Fig. 9) and used as described on p. 50.

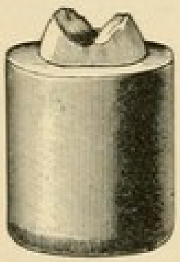


Fig. 9.

Ash's Mineral Teeth. The following notes on Ash's mineral teeth were put together some time ago in reply to questions from the Firm. As others have from time to time asked me similar questions, the notes may perhaps be usefully given here.

Although Ash's mineral teeth have now been before the profession for close upon sixty years, and many references are made in dental literature to the fact that they are of the same non-porous texture throughout and can therefore be ground and polished to any extent that may be desired to suit special cases, it is yet remarkable that no writer has attempted to give definite instructions for grinding and polishing them.

By way of introduction to making such an attempt, I may say in the first place that the density of these teeth permits of their being ground to a very fine edge without the risk of chipping, and, if necessary, the ground surfaces can afterwards be highly polished. A further advantage is the absence of the particles of porcelain which in some teeth are found encroaching upon the pins, as the removal of these particles in the process of backing teeth involves both annoyance and loss of time.

To grind the teeth. For this purpose I use carborundum or corundum wheels running in a trough of water when doing work with the lathe, and carborundum or corundum wheels and points when doing it with the dental engine.

The use of carborundum pretty well does away with the need for a steel tool in countersinking, but, where a dental engine is not at hand, the teeth may be countersunk by means of a graver and camphorated turpentine into which the graver is dipped from time to time. But, of course, every well-equipped workshop should be provided with a dental engine.

To polish the teeth. This is a process which I seldom find it necessary to carry to any great length. An Arkansas stone run in the dental engine and kept wet gives a very fine surface. No. 1 glass paper used dry will add a further gloss. Where a yet finer surface is desired, I use a buff carrying putty powder, and finally finish with whiting.

The following articles for the double purpose of grinding and polishing will meet all requirements.

Equipment for use with the Dental Lathe:

(1) A carborundum or corundum wheel for grinding the tooth to shape.

(2) An Arkansas wheel or an Ash's polishing wheel for removing the marks left by the carborundum or corundum and for smoothing the ground surface.

(3) A brush or buff wheel, some superfine pumice or putty powder and some whiting for polishing. Note—water to be used at every stage.

Equipment for the Dental Engine:

(1) Carborundum or corundum wheels and points.

(2) An Arkansas or Water of Ayr stone.

(3) A brush or buff polisher, some superfine pumice &c., as under No. 3 above.

Equipment for hand use:

(1) A half round carborundum or corundum file.

(2) A hone of Arkansas or Water of Ayr stone.

(3) A hand buff, some superfine pumice &c., as under No. 3 of Dental Lathe equipment.

To shorten a tube-tooth. If Ash's tube-teeth are shortened by a forcible grab with the cutters usually supplied,

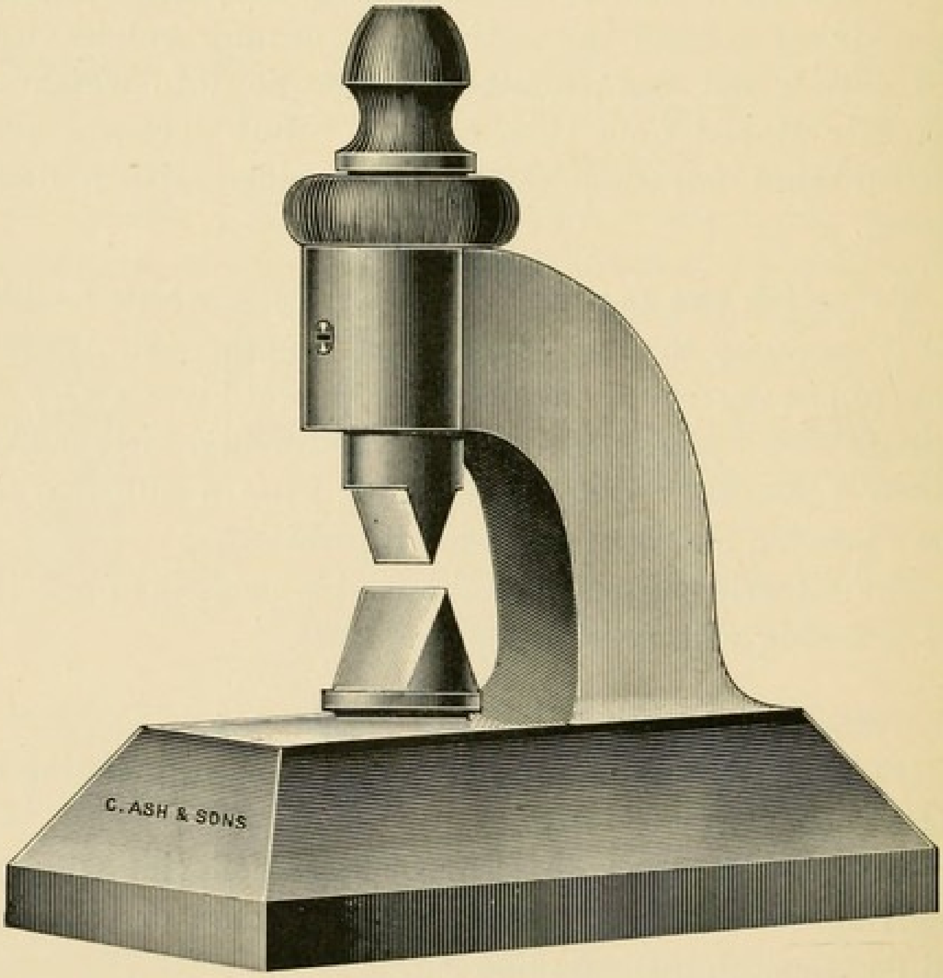


Fig. 10.

they are very apt to be splintered and otherwise damaged in a way that gives much trouble, even if it does not altogether spoil the teeth. The cutters which I use (Fig. 10), and which are not nowadays figured in the catalogues, consist of two chisel-like edges facing each other, the upper one being capable of up and down movement so as to somewhat resemble a miniature guillotine. Placing the tooth to be shortened between these edges, I give the back of the upper edge a tap smart enough to just crack the tooth through to the tube; then with a thrust of a sharply tapering steel rod inserted in the tube, I am able to burst off the superfluous part of the tooth without in the least damaging the part required. The exposed portion of the tube is then, of course, easily sawn off.

To mark the positions of the pins for tube-teeth. Having roughly ground down and adapted a tooth to the position intended for it, I fasten it temporarily to the plate, and, passing through the tooth a broach, sharpened as a drill, large enough to nearly fill the tube, and carried in a socket handle such as is used for hand-burs, I mark the position for the pin, taking care to support the tooth while doing so. Then, taking a much finer broach sharpened as a drill and carried in a drill-stock, I drill a hole for the pin in the position marked, the mark having been made sufficiently deep to prevent the drill from slipping in ordinary cases. Should the mark happen to be on a steeply sloping part of the plate and not on the top of the ridge, to avoid the slipping of the broach while drilling, I first drill a small hole nearly through the plate at the mark, holding the broach meanwhile almost perpendicular to the plate at that point. Then, slipping the tooth on to the broach and using it as a guide for the direction in which to proceed, I finally enlarge the hole to the size required for the pin.

Soldering pins to plates. When pins for tube-teeth are to be soldered to a plate, the use of wire to tie them in position may be avoided by placing a good-sized lump of asbestos fibre upon the wig and by so resting the plate upon it that the pin to be soldered shall be vertical, or shall lean slightly away from the direction in which, at the moment of soldering, it has a tendency to fall.

Asbestos is a good material to use as a support, as it is light and takes up but little heat. A small quantity will last an indefinite time.

Fitting a gold plate with side-pieces for swivels. Though somewhat of a digression, a description may conveniently be given here of my method of proceeding when fitting side-pieces to a gold plate.

The teeth being in position on the pins, I remove two at some distance from, and on either side of, the position intended for the side-piece, and, twisting a piece of wire round one of the exposed pins, I pass it along the front of the teeth remaining in position, past the position for the side-piece, and on to the other exposed pin round which I secure it (Fig. 11). Then, removing all the teeth and pushing the wire its own width nearer to the pins, I bring the outer side of the wire to the position of the surface of the teeth previously touched by it. Assuming that the plate has already been marked along the necks of the teeth, I next apply ground borax to that part of this mark at which the side-piece is to be fixed, place the side-piece there, and, leaning it against the wire above-mentioned, I proceed to complete the soldering.

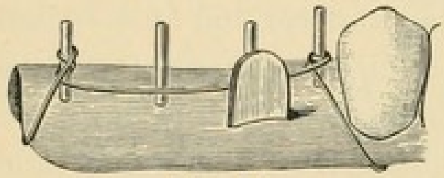


Fig. 11.

Backing and soldering teeth. When backing a tooth, my plan is to counter-sink the back and rivet with a fine-edged hammer, supporting the tooth meanwhile on the edge of a piece of lead held in a vice. This I think better than splitting and spreading the pins, as some recommend, because the borax and solder are more easily kept from flowing through the back and fracturing the tooth. In soldering I use a jeweller's wig on which is placed a sprinkling of asbestos fibre to prevent the discoloration and cracking of the teeth, the soldering being done without investing. The teeth are then allowed to cool, and the backs are filed up before the teeth are waxed in position on the plate. When in position, the teeth are invested in sand with a slight admixture of plaster, and the final soldering is done in the usual way.

In making a gold bicuspid crown with a mineral face, I am able by the above method, that is with asbestos fibre on a jeweller's wig, to make use of the mineral face to hold the back in position while tacking the back to the crown, and this without investing and without cracking or discolouring the face. Then, removing the face, I complete the soldering. To fasten the tooth to the back I merely bend the pins towards the cutting edge of the tooth and do not solder them.

To solder a post in a tube-tooth. When making a dowel-crown with a tooth in which the dowel is not already fixed (see page 82), I insert the thick or root end of the post

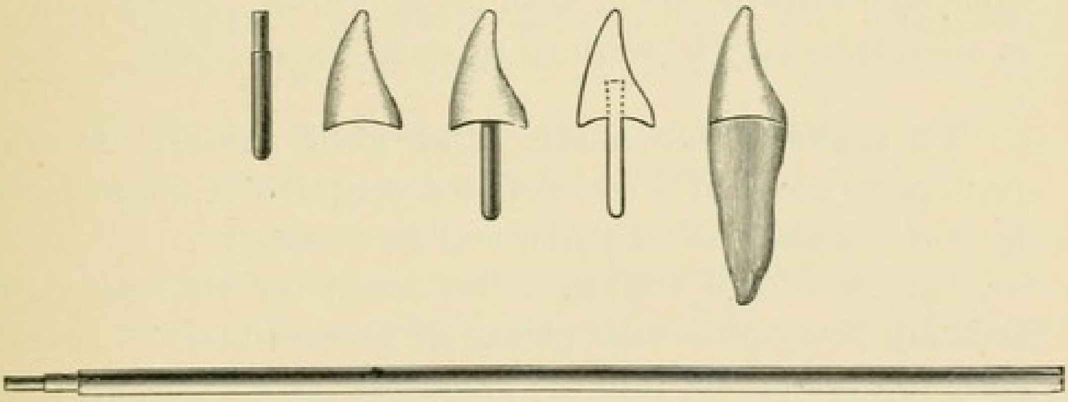


Fig. 12.

or dowel into a light copper tube with an open seam (Fig. 12) which will hold it without carrying off too much heat; tin the end of the post which is to enter the tube of the tooth; apply zinc-chloride as a flux to tube and post; lodge the tooth on the point of the post; hold over a gas-flame and drive the tooth home, being careful that the post takes its proper position, which in the case of an ordinary tube-tooth will be shown by the facet at the end of the post properly fitting the surface of the tooth.

Soldering a pin-tooth to a plate in the neighbourhood of a band. In the process of soldering a pin-tooth to a plate next to a band, the solder is apt to flow between the edge of the plate and the band, and so render the band rigid just where it is required to be free. This may be prevented by rouging the band, but the band should be rouged and dried over a gas-flame before the tooth is waxed into position for soldering. There will then be no risk of rouge getting on to the back of the tooth, or between the back and the plate, and so obstructing the flow of the solder to places where it is required.

To cement tube-teeth to a gold plate. In cementing the teeth to the pins on a gold plate, I warm the pins and dip them one after another in a spoonful of melted sulphur. Then heating a tooth held in grooved pliers, I set light for an instant to the sulphur on a pin, blow it out, and force the tooth home, taking care that the tooth is hot enough to melt the sulphur as it passes on to the pin, and proceeding in the same way with the other teeth till all are on. If the plate is of all-gold, it may be warmed to assist the operation.

To make silver solder and gold solder. It may perhaps be useful if I add here a description of the methods by which I make silver solder and gold solder:

Take 8 dwt. of sterling silver; melt it; wrap 4 dwt. of ordinary brass pins with plenty of ground borax in paper, and drop the packet into the molten silver, stirring with the stem of a clay pipe. Cast, and roll. The alloy obtained is silver solder.

Add 8 grs. of this alloy to 1 dwt. of any gold to be worked with, and you have the quality of solder suitable for that gold. In adding the alloy to the gold proceed as follows:

Melt, say, 3 dwt. of gold; paint 1 dwt. of silver solder with ground borax; drop it into the molten gold; stir with a pipe stem; cast and roll, and you have 4 dwt. of gold solder.

Polishing wheels and points. Since writing the above notes (pp. 18—20) on the grinding and polishing of Ash's Mineral Teeth, I have received from Mr Brunton a number of wheels and points of his invention by the use of which a very satisfactory surface is produced without further polishing. The shanks on which the engine wheels and points are carried are made thin towards the wheel or point to facilitate access to difficult parts. The shanks are also furnished with small washers to prevent moisture from getting into the hand-piece.

To centre wheels upon a lathe. In cases where the spindle of the lathe is too small for the hole in the wheel to be centred, the adjustment may readily be made by wrapping a strip of soft sheet-copper of the requisite thickness about the spindle. The collar thus formed should be left open at the seam, and the strip from which it is made should be rather narrower than the thickness of the wheel, so that the collar may not take the pressure of the washer or nut from the wheel, when the nut is screwed tight. In putting on a wheel, first slip a suitable collar into the hole in the wheel, and then slip collar and wheel together on to the spindle.

Method of wetting wheels on the lathe. The use of dripping water and a sponge for wetting wheels on a lathe to which I was accustomed as an apprentice is objectionable as being both messy and inefficient, and for the last 33 years I have used a pan or trough of water. This stands under the wheel and behind a rail fixed to the bench for the hand to rest upon. The result is that there is no splashing, the débris from grinding is wholly taken up by the water into which it sinks, the wheel is kept constantly clean and thoroughly wet, and, in the case of carborundum, the cutting qualities appear to be actually improved by the soaking.

Repairing a cracked vulcanite plate. A few words upon the repair of a cracked vulcanite plate may well bring these few remarks upon methods to a close. For a method of preparing a die and counter and striking up a plate for use in such cases the reader is referred to the chapter on fusible metal (page 44). Such plates are usually attached to the vulcanite by drilling and riveting, but there are cases in which, owing to the position of the teeth, it is impossible to rivet the plate sufficiently close to them to prevent movement of the parts near them. Such cases may, however, be very effectively repaired by attaching a small thick plate quite close to the teeth by means of short, rapidly tapering screws. The method of making such screws is described on p. 32. It should be added that in riveting to vulcanite, while it is necessary to countersink the plate, in the vulcanite no countersinking is required. It is even attended by disadvantage, as a trial will readily prove.

To remove the model from the sand when about to cast a zinc. There is a hint, which it may be worth while to add, on the method of removing the model from the sand, when about to cast a zinc. The common method of driving a sharp point into the model, especially when the model is thin or over-dried, is a troublesome and sometimes risky operation often attended by failure. If by another method small portions of the sand are removed so that the model may be lightly grasped, the zinc comes out with some unwelcome additions, however small.

A better plan than either of these is to let fall a drop of wax upon the centre of the back of the model when embedded in the sand, or earlier if a Pearsall flask be used, and to press down upon the wax a heated metal disc, say a farthing, furnished with a handle, which may be a second farthing standing edgewise on the first and soldered to its centre. By this handle the model can be lifted without the least risk of its falling back; and a very little heat applied to the disc suffices for its removal from the model as well as for its attachment to it.

CHAPTER II.

A FEW TOOLS AND INSTRUMENTS.

In this chapter I propose to devote a few words to certain tools and instruments, in some of which I hope to be able to suggest improvements, and it will perhaps interest those who take pleasure in making their own tools, if, in the first instance, I briefly refer to such as I make for myself.

First in order of use among these, but so simple as hardly to deserve mention, is **a contrivance for saving impression trays** (Fig. 13) from damage when rapping them in

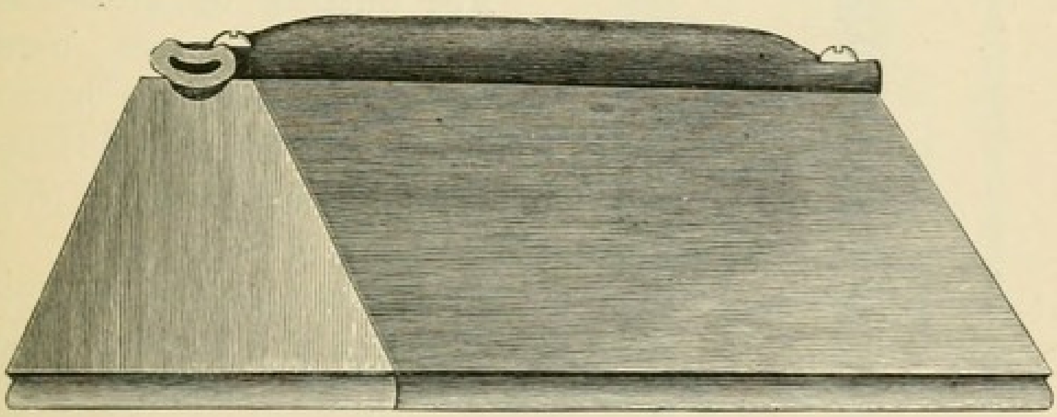


Fig. 13.

order to shake down the plaster into the impression. It consists of a piece of wood, some inches long and of triangular section, which consequently, when placed upon the bench, presents one edge upwards. Upon this edge a piece of rubber tubing is tacked, and upon this tubing trays may be rapped quite harmlessly.

Another point in connexion with trays may be mentioned here. If, when a model has been cast and the plaster is set, an attempt is made to remove the tray by heating the composition in hot water, some of the composition is apt to remain adhering to the tray, and is then very troublesome to remove. If, on the other hand, cold water from a tap be allowed to run over the tray so as to get rid of the heat generated by the setting of the plaster, and causing the adherence of the tray, the tray may be readily removed in a perfectly clean state by inserting a knife between the tray and the composition, at one or both heels of the tray.

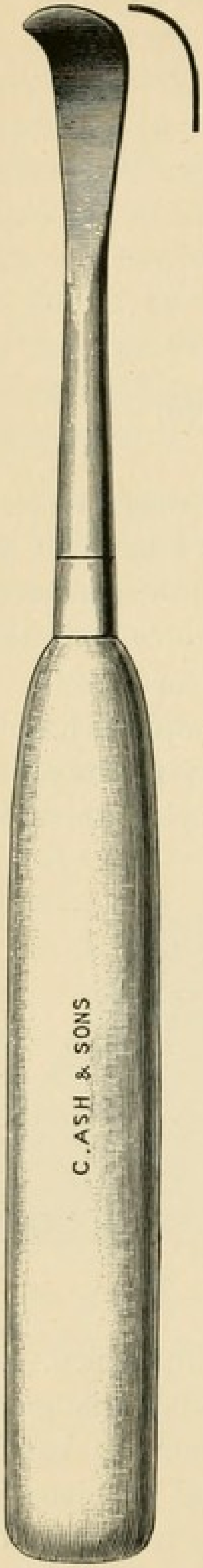


Fig. 14.

Fig. 15.

For cutting up vulcanite work, I make two **bent scrapers,** one from the handle of an old gold file (Fig. 14), the other from an old hand-bur (Fig. 15).

In the case of the old gold file, I soften the handle ; make one side quite flat and smooth ; then turn up the end, while hot, flat side inwards ; file into shape, and harden. To sharpen, I have only to grind the outer side of the bend at the margin, when the smoothness of the inner side of the bend gives a good cutting edge. In the case of the hand-bur, I soften and flatten the bur; grind the disc so obtained flat on one side; bend up towards that side; harden and sharpen, as before. The excellence of the material from which the files and burs are made leads me to prefer the scrapers thus obtained to those supplied by the depôts.

Among other tools **for the same purpose** I have a **scraper made from a three-sided file,** a **knife-edged file,** and an **oval root-file** for going inside lowers.

For removing vulcanite from between the teeth I use an old **excavator** brought to a needle point: this is also of use in shortening tube-teeth as already described (p. 20).

For waxing up a case I have an old **pocket knife** with the small blade brought to a point by grinding away its

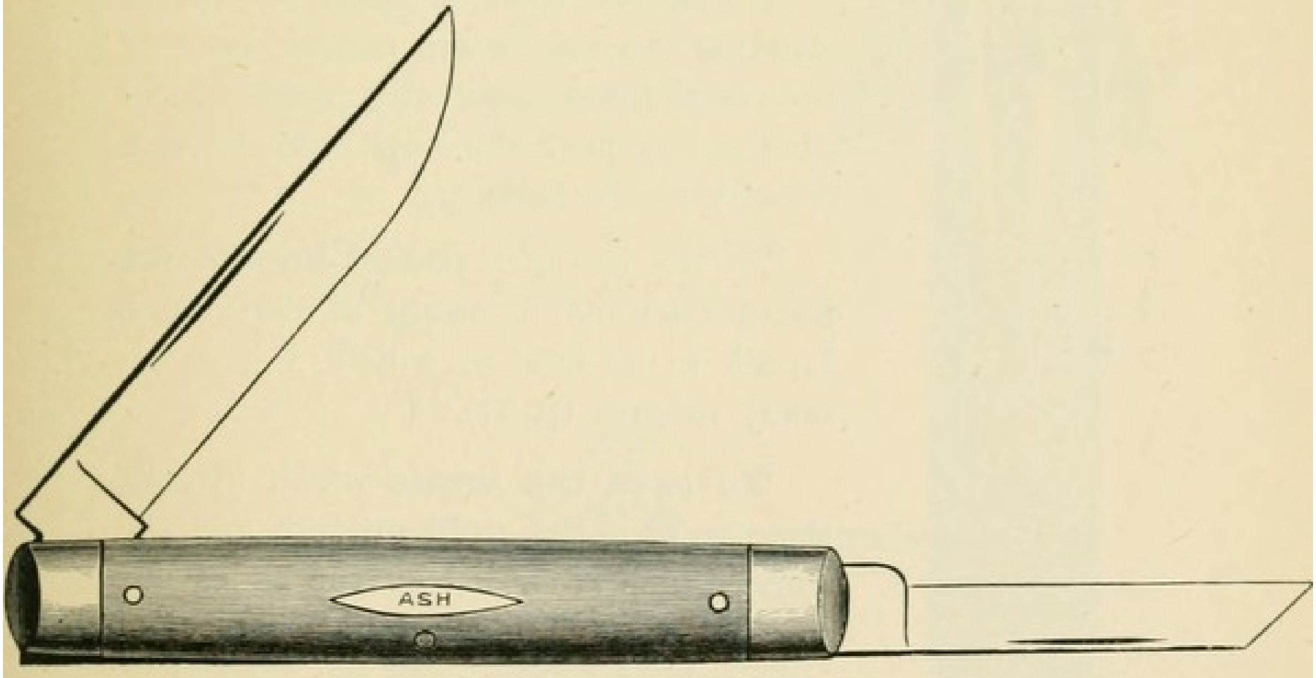


FIG. 16.

original point until both back and edge are straight but the back the shorter, thus: (Fig. 16). A piece of copper wire heated is also useful in such work. The large blade of the knife is used for **trimming plaster** when investing.

For scollopers and gouges I discard the **handles** usually supplied for them, and fit them with handles such as engravers use. To do this, the handle end of the scolloper, say, is bent at right angles and brought to a point. This point is driven into the side of the piece of wood intended for the handle, and cord is then used to bind the scolloper to the handle (Fig. 17). In this way the gouges and scollopers can be made to project a convenient distance from the handle at the outset, and can be lengthened from time to time as required, whereas with the handles supplied they project at first too far, and there is a temptation to be wasteful by breaking them short.

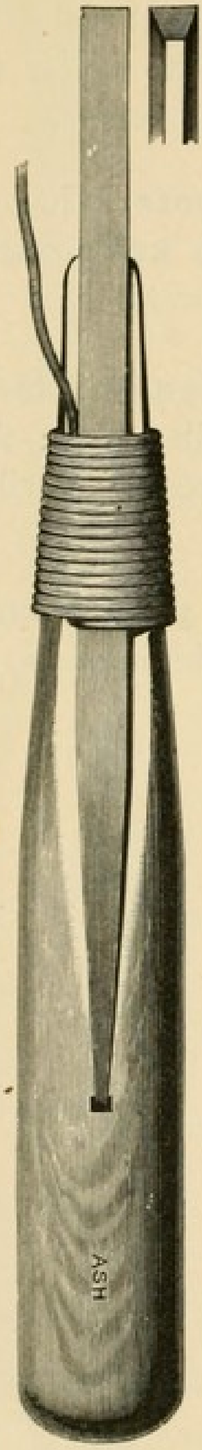


Fig. 17.

I may add that I find it useful to chamfer the two edges of the back of the **scollopers** ordinarily supplied, in such a way that the back may be narrower than the front.

To the use of a **socket-handle for hand-burs** as a means of carrying a broach to be used as a drill I have already referred (p. 21).

To save the waste which attends the use of naked **gold cutters** and the worry which is caused by the endeavour to catch the clippings, I draw a piece of india-rubber tubing over the jaws (Fig. 18). As the clipping goes on, the pieces are caught in this tubing or sheath without any attention on the part of the workman, and are readily emptied out when the clipping is done. The tubing perishes, of course, after a time and becomes ineffective, but is easily renewed.

Of instruments for use in the surgery I may mention a small **saw** (Fig. 19) which will cut in a direction at right angles to the plane of its frame, and which is consequently useful for removing the crowns of incisors when the roots are to be crowned. Finding the frames of saws of this kind, as supplied by the depôts, deficient in substance, I made one for myself by adapting the frame of a piercing-saw. To do this I had merely (1) to shorten, and cut slots in, the sides of the extremities of the frame to receive the saw-blade, and (2) to prevent the blade from pulling out, when in action, by attaching a small bead of solder to either end of the blade. This bead is obtained by making the end of the saw-blade bright, dipping it in a solution of zinc chloride, then in melted solder, again melting in the gas-flame the solder which adheres, and tilting the blade so that the solder runs to the end of it and forms the bead desired. The blade is,

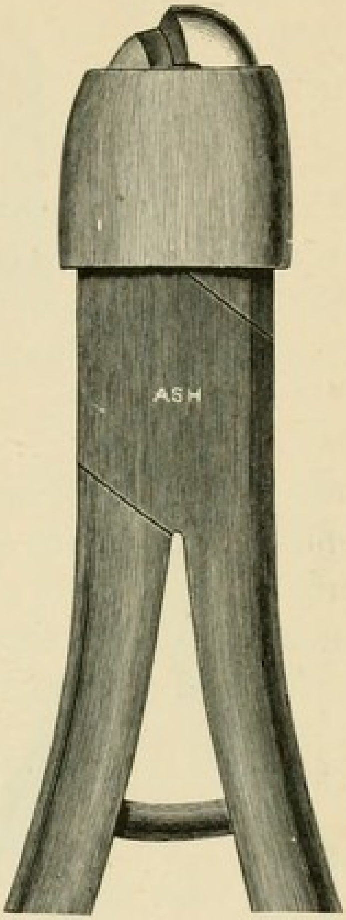


FIG. 18.

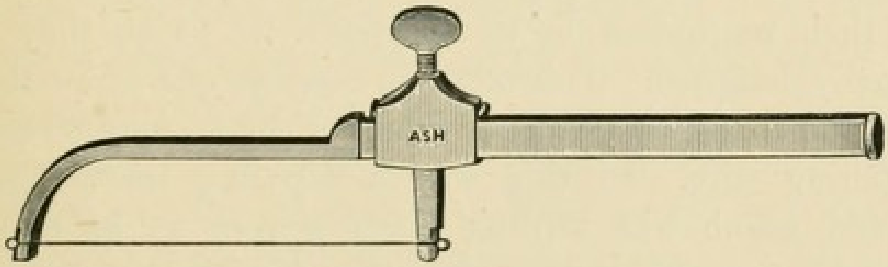


FIG. 19.

of course, cut in the first instance of such a length that there is just sufficient length left between the beads to suit the frame.

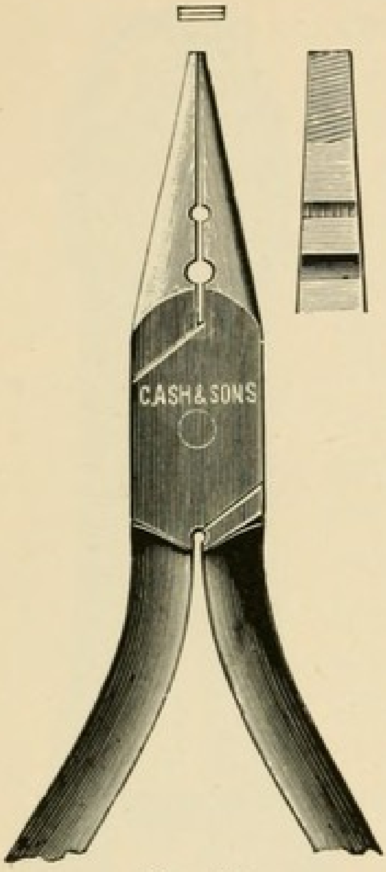


FIG. 20.

The screw-cutting pliers shown in Fig. 20 were designed in the first instance with straight slender chops, closing only at the extremities, for the purpose of grasping a strip of copper about a bicuspid root when crowning by a method to be described later on. Without further addition they were, and are still, a useful tool in the workshop for general purposes, in particular for bending the pins in pin-teeth, and for adjusting the pins for tube-teeth, the long slender chops especially fitting them for these purposes. But a suggestion gained from seeing the late Dr J. J. R. Patrick of Belleville, Illinois, at work with a screw-cutting appliance of his own, when on his last visit to England, has enabled me to suggest the addition of a very

FIG. 21.

valuable feature to these pliers without in any way detracting from their usefulness for the purposes for which they were originally designed. This addition consists of a screw-thread cut in the chops, by means of which a thread may be cut on a tapering wire. In this way a tapering screw post is obtained which will tap for itself a root to be filled or crowned. For the opportunity of seeing Dr Patrick I am indebted to Dr G. Cunningham.

The method of making a screw post is as follows: File a piece of wire, of dental alloy for choice, to a suitable taper as shown at the right-hand end of the piece of wire represented in Fig. 21, and, holding the wire in a hand-vice, grasp the thick end of the taper first with the pliers, and gradually work out the wire from the pliers. Repeat this three times, beginning always at the thick end of the taper. The pressure on the pliers should be steady and oil should be used. For the method of inserting such a post into a tooth see page 36.

A further addition to these pliers was borrowed from an advertisement and consists in a plain orifice, nearer the base of the chops, for inserting and removing cone-socket points.

I may perhaps be forgiven if I recall here that at Glasgow in 1887 I showed a **cervical clamp** to which clamps afterwards advertised under the names of Dr St George Elliot and Dr J. Leon Williams bear a strong family likeness. I am not in a position, and do not wish, to argue the question of priority, but I claim that the screw cervical clamp I then showed was original so far as I was concerned.

Fig. 22 shows a modified form of this clamp, the rear limb having a screw adjustment by means of which the length of the limb can be adjusted to suit any given tooth. This is new.

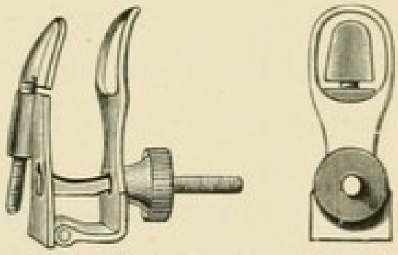


FIG. 22.

There are three other articles in which I am able to suggest modifications which I hope will prove useful.

The first of these is the **hot-water syringe** for washing out cavities. The syringe in ordinary use has several disadvantages. It takes a long time to fill, the water is consequently much cooled during the process of filling, and, when the water is cold, time is again lost in expelling it from the syringe.

The syringe shown in Fig. 23 is furnished in the nozzle with a valve actuated by a light spring. When the syringe is to be filled, the neck of the bulb, just above the milled nut, is taken between the forefinger and the middle finger, the bulb is compressed either by the thumb acting on its base or by the remaining fingers and the palm of the hand, and the valve is at the same time opened by pressing the nozzle against the bottom of the vessel containing the hot

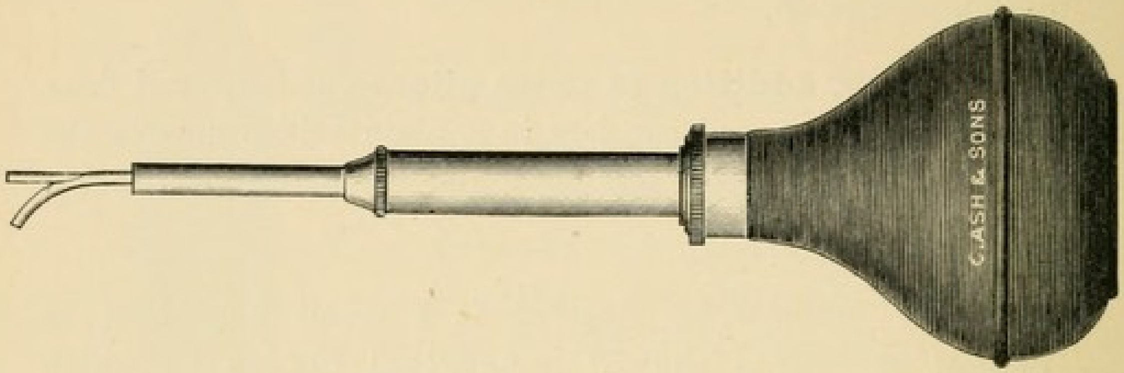


FIG. 23.

water. The bulb being quickly filled and the nozzle withdrawn from the water, the valve is closed by the action of the spring, and the syringe is ready for use in the ordinary way, or it may be emptied again immediately by pushing back the nozzle while compressing the bulb. Whether to fill or to empty the syringe but one hand is needed.

The second article referred to above is the ordinary **vulcanite flask.** When a case is invested in one of these flasks in the manner described on page 12, it is difficult, owing to the sides of the flask being equally deep at all points, to get at and remove the superfluous plaster about the extremities of the plate. I have accordingly varied the depth of the rear side of the flask in the manner shown in Fig. 24.

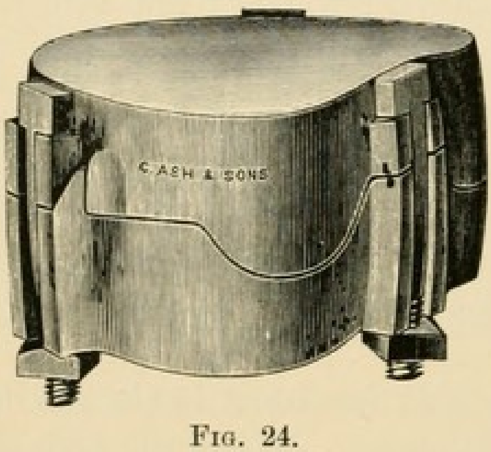


FIG. 24.

A further difference from the ordinary flask is the adoption of guides, the front edges of which slope backwards from the vertical and so allow the parts of the flask to be brought together in a manner suited to plates in which a section through the central line would present a hooked

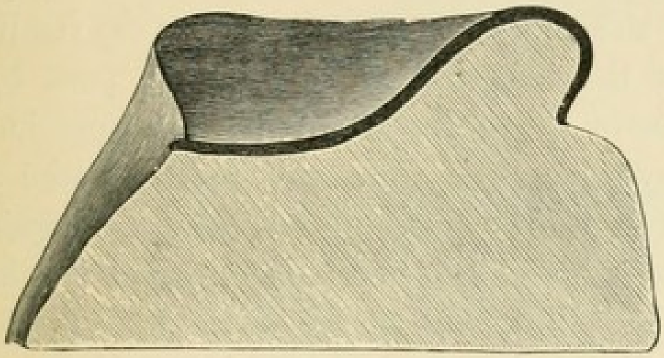


Fig. 25.

appearance, as shown in Fig. 25. I have been obliged for many years to file away the ordinary upright guides to meet cases of this sort.

A third article with regard to which I have a suggestion to make is the **wire- or broach-holder.** This is of great use in inserting screw-posts, but if the holder is small and light, as it should be for use at the mouth, there is difficulty, owing to the smallness of the milled nut, in screwing it up tightly enough to give the holder sufficient purchase upon the tapped wire, and its slipping involves an annoying loss of time.

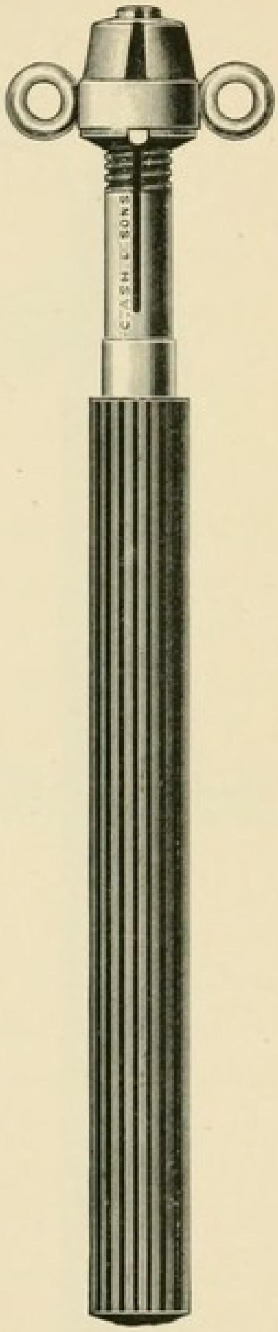


Fig. 26.

Accordingly, having made a groove along the nut, I have fitted to the latter a small spanner (Fig. 26) with a feather corresponding to this groove, and have since had no difficulty in making the holder grasp the wire securely.

It would, however, save the addition of the above spanner to the already over-large number of instruments we require, if an extra hole were made in the engine-spanner to fit the nut of this broach-holder.

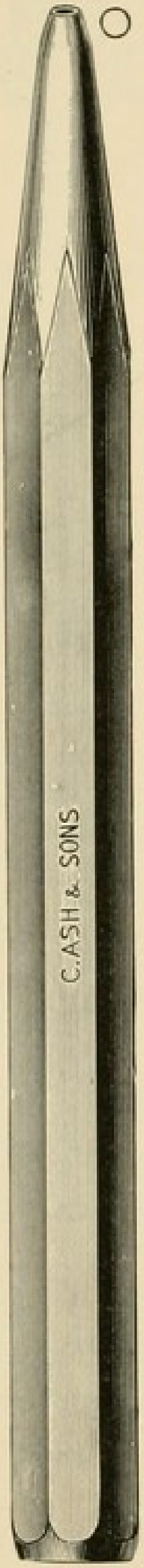


Fig. 27.

To insert a tapped-wire post into a tooth, fix the tapped wire tightly in a broach-holder and screw it into the tooth, thus tapping the tooth by means of the post itself; mark the length required for the post by means of a bristle dipped in chloro-percha; remove the wire from the tooth; make a nick in it at the point marked, and again screw it home into the tooth until it breaks at the point where the nick was made. Sometimes, before breaking the wire, my partner replaces it temporarily by a gutta-percha point equally thick but less obstructive.

Some simple **tools** I made years ago **for use in affixing heads to swivel-bolts** may perhaps deserve mention, as the making and using of such tools would furnish useful exercises for students.

The **first** of these (Fig. 27) consists of a large round file in the end of which a hollow has been drilled, the margin of the hollow being brought to a sharp edge by filing and rubbing on a stone. By driving this tool through a piece of sheet-gold (No. 5 or 6 Ash's gauge) placed upon lead, we may cut out and dome up a bolt-head at one blow.

The **second tool** (Fig. 28) is a piece of tinned iron cut and bent into something resembling a pair of sugar-tongs, having at one end a sort of spoon fitted to receive the bolt-head, and at the other a merely flat surface. The tin is, of course, burnt off the iron before making up this tool.

The purpose of the tool is to hold the

bolt and the bolt-head in position while soldering them together. The bolt-head should be filled with solder and the surface of the solder should then be made flat.

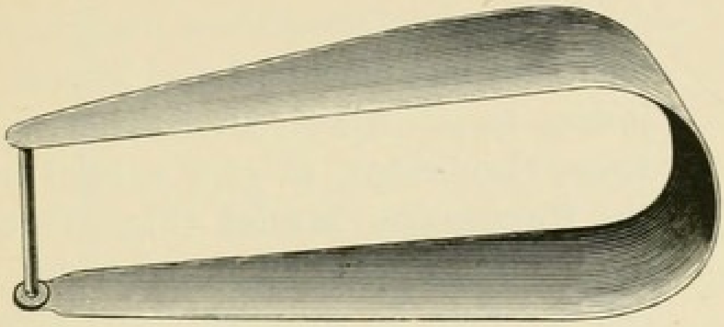


FIG. 28.

This is done by means of a **third tool** (Fig. 29) which consists of an old excavator handle, down the centre-line of which a hole has been drilled for, say, about a quarter of an inch. A part of the side of the handle is cut away to

FIG. 29.

beyond the centre-line so that the far end of the hole before drilled becomes exposed; the end of the handle is filed or turned to the size of the bolt-head and the extremity is made flat and smooth.

The bolt having been boiled in pickle is inserted into the hole in this tool and driven down with a few taps from a small hammer, until the solder is flat and smooth. The head of the bolt is then filed and polished, and the bolt is removed from the tool by means of the opening at the side.

It is obvious that with bolts made in this way, a silver bolt and silver solder can be used without detriment to the appearance of the work, the head being of gold.

A convenient **tool for making a flat surface** of the proper size **to receive the swivel, or a washer** for the swivel, in a vulcanite case, may be made from an old gold file by cutting the end into the form of a centre-bit as shown in Fig. 30. The tool should be carried in a socket-handle.

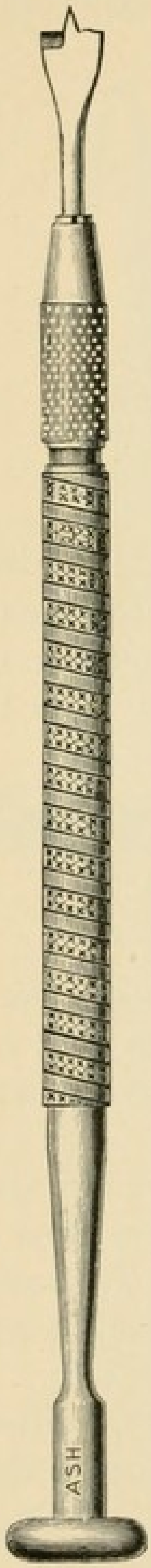


Fig. 30.

Before concluding these few remarks about tools and instruments, I feel bound, if only in justice to my friend, Mr F. Thomas, of Jesus Lane, Cambridge, to give a brief account of the **Pneumatic Mallet** (Fig. 31) with which our names are associated and which upon my call for help he so quickly and ably devised. Moved by the complaints of my partner about the inefficiency of the mallets he had tried, I applied to Mr Thomas, whom I knew to be an inventor by nature and accustomed to make a variety of scientific instruments for men of science in the university. In a very few days, he produced the idea which was ultimately developed into the perfected instrument as shown at Exeter in 1890, and I felt and feel so satisfied with it that I have never hesitated and do not now hesitate to endeavour to impress operators with a sense of its utility. Its action is of the simplest kind, and it is remarkably free from liability to get out of order. A comparatively imperfect instrument of the kind was used by my partner for years without needing any attention to speak of. If there is any drawback to its use, it lies in the fact that, as placed upon the market, it has to be driven by a Fletcher's blower which must either be worked by the operator himself or by an attendant. But this is no fault in the mallet as such, and those who object to either alternative might readily avoid them by the use of air-pressure derived from a species of gasometer which could easily be contrived so as to give sufficient air-pressure for a day's work.

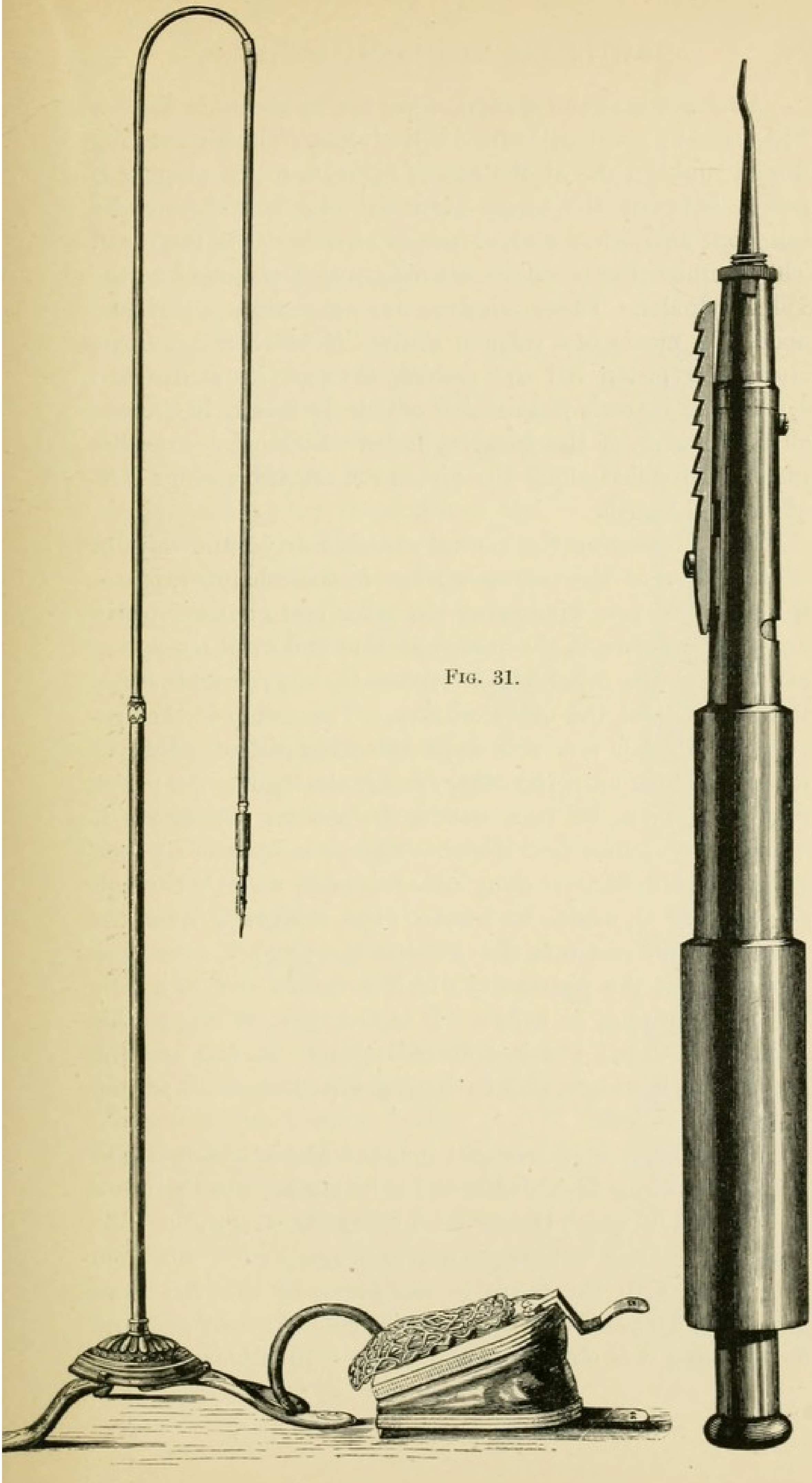


Fig. 31.

A reference to the section of the mallet shown in Fig. 32 will make its construction and action clear. The air entering from a rubber tube at the end *H* opposite to the plugger *E* passes between the larger outer cylinder and the smaller inner one and enters a small central chamber *G* in the inner. This chamber has openings or windows at both ends into the inner cylinder. These windows are alternately closed and opened by means of a valve or shutter *M* which moves freely along the piston rod *CC* passing through its centre and carrying at its ends pistons *BB′* which fit loosely in the end chambers *AA′* of the inner cylinder. Starting from either piston and coiled along the piston rod are two springs *NN′* of unequal length.

The air entering the central chamber drives the valve or shutter over to the nearer window in that chamber, passes through the open window at the other end of the chamber and drives before it the piston at that end until the spring attached to the other piston strikes the shutter and pushes it over to close the other window. The action is then reversed. The air now acts upon the other piston and drives it away in turn until the other spring, attached to the piston first acted on, in its turn strikes the shutter and drives it over to the window first closed. The air in front of a piston which is being driven away either escapes directly through an opening *O* made by moving the ratchet *Q* near the plugger, if the piston is that nearest the plugger, or escapes first through the piston rod which is hollow and so out by the same opening as before. It is clear that so long as this opening is closed the instrument remains at rest and the operator is, therefore, able by letting slip the ratchet to stop the mallet at once.

The plugger is so arranged that the nearer piston strikes it like a hammer towards the end of its stroke, and there is a contrivance by which the socket holding the plugger and the plugger itself can be brought nearer or removed farther from this piston, with the result in the first case that the blows become lighter and faster, and in the second case slower and heavier, and it is obvious that a wide range of blows may be thus obtained from the very hardest to a scarcely perceptible touch.

The instrument readily gives upwards of 1000 blows a minute, as may be easily proved by allowing it to strike a sheet of paper while working for, say, five minutes and then dividing the number of dots made by the number of minutes in which they were made. The variety in the force of the blows may be similarly tested by allowing the plugger to strike a sheet of lead and noting the depth of the indentations.

The plugger points are easy to insert and remove, but when a rapid succession of different pluggers is desired, it becomes a nuisance to have to insert and remove them. This is a difficulty incidental to all mallets, but with this mallet might be readily overcome by suspending five or six mallets at once by separate rubber tubes all connected with one metal cross-tube supplied by a main tube from the blower or gasometer. The operator could then catch up any one of the six he chose, and, the others remaining inert, he would still have the full force of the air supply through the one he was working with.

The success which this mallet has met with hitherto has unfortunately not been such as to reward Mr Thomas for the ingenuity and labour expended upon it, but for those who need a mallet and do not rely entirely upon hand pressure I am satisfied that there is no more effective instrument to be had.

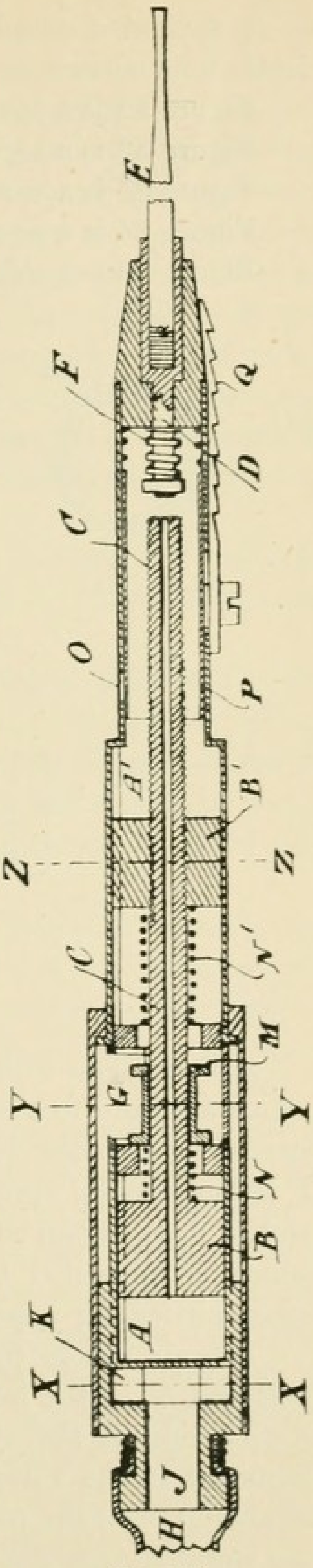


Fig. 32.

I append a detailed description of the sections of the instrument shown in Figures 32 to 36.

Figure 32 is a longitudinal section.

Figure 33 is a section on the line *XX* (Fig. 32).

Figure 34 is a section on the line *YY* (Fig. 32).

Figure 35 is a section on the line *ZZ* (Fig. 32).

Figure 36 is a side elevation of one of the parts.

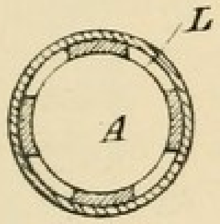


FIG. 33.

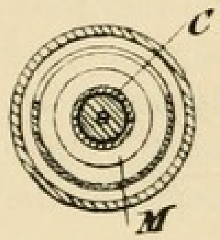


FIG. 34.

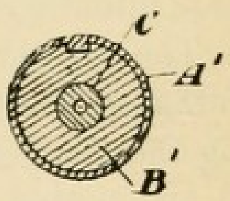


FIG. 35.

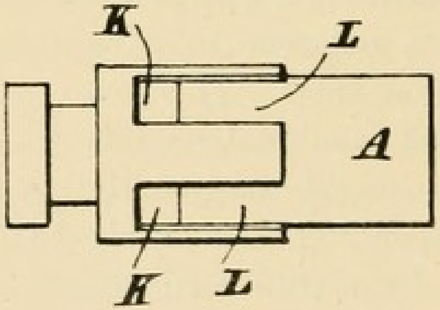


FIG. 36.

AA′ are two cylinders in which work the pistons *BB′* which are fixed to a common piston rod *C*, the end of which strikes against the holder *D* which carries the plugger *E*, *F* being a spiral spring which tends to bring the parts *D* and *E* back again after a blow. *G* is the valve chamber which is connected by the flexible tube *H* to bellows or other air-forcing apparatus.

The air enters by the pipe *J*, passes along the radial passages *K* to the longitudinal passages *L* formed between the outside of the cylinder *A* and the casing of the instrument to the valve chamber *G* in which works the valve *M* sliding upon the piston rod. The valve *M* is actuated by the spiral springs *NN′*.

When the parts are in the positions shown in Fig. 32, air is being admitted from the valve chamber *G* into the cylinder *A′* and is tending to force the piston *B′* forward. As soon as the aperture *O* in the casing is opened by pushing forward the tube *P* by means of the serrated thumb-piece *Q* fixed to it, the piston *B′* will move forward and the blow will be struck. Meanwhile the spring *N* will have been compressed and the spring *N′* relieved so that the valve *M* will be shifted so as to cut off air from the cylinder *A′* and admit it to the cylinder *A*, when the reverse action takes place, the motion continuing so long as the opening *O* is uncovered by the tube *P*, and the rapidity of the blows can be varied by more or less covering the opening *O*.

The piston rod is made hollow so that air from the cylinder *A* as well as that from the cylinder *A′* escapes through the opening *O*.

The instrument is also furnished with a milled nut at the plugger end (not shown in the section Fig. 32), by giving partial turns to which the distance of the plugger *E* and its holder *D* from the end of the piston rod *C* can be varied whereby the force and rapidity of the blows admits of nice adjustment.

As shown in the drawings, the piston *B′* forms a nut upon the screw-threaded piston rod and is grooved as shown in Figures 32 and 35 to receive a feather upon the casing so that by turning the casing the distance of the pistons apart can be varied.

In some cases a fixed stop or abutment is provided to receive the blow at times when it is not desired that the holder carrying the plugger should be struck. A spring is applied in connexion with the plugger-holder in such manner as to press it forward away from the striking end of the piston rod. The blow is then struck upon the fixed stop, and only reaches the plugger when by pressure exerted by the operator with the point of the plugger the spring is compressed and the plugger-holder is caused to recede until it comes within range of the blow.

CHAPTER III.

SOME USES FOR FUSIBLE METAL.

THE following is an account of the various uses for Fusible Metal described by me in a paper read before the London Meeting of the British Dental Association in 1891.

Full information as to the constitution of the several alloys to which the name of Fusible Metal has been given and as to the several temperatures at which they melt may be readily obtained from the text-books of Chemistry and from Harris's *Dictionary*. I will therefore only say in passing that these alloys are made up of lead, tin, and bismuth with or without cadmium; that they melt at varying temperatures below the boiling point of water, and expand about 3 per cent. on cooling, thereby affording a very sharp impression even of fine scratches on the object from which a cast is taken with them.

Having for many years had a small piece of one of these alloys in my possession, I found occasion in the autumn of 1890 to make some experiments with it, and, one thing leading to another, I had the good fortune to arrive at the several ways of employing it which I am about to explain.

These ways are three in connexion with crown-work, two with the repair of vulcanite plates, and three with the manufacture of new plates.

First, as regards **crown-work.** In this class of work the metal may be used:—

(*a*) To make a mandrel for shaping the ferrule or collar.

(*b*) As a setting for a natural tooth, to be used as a die for striking up crowns.

(*c*) As a means of obtaining a well-defined and not readily damaged cast of the mouth when a tooth is to be pivoted.

The **mandrel,** of which a specimen is shown in Fig. 37, is obtained as follows:—

A thin strip of copper (Fig. 38), in the form of a portion of a flat ring, is formed into a ferrule, with plane edges and a

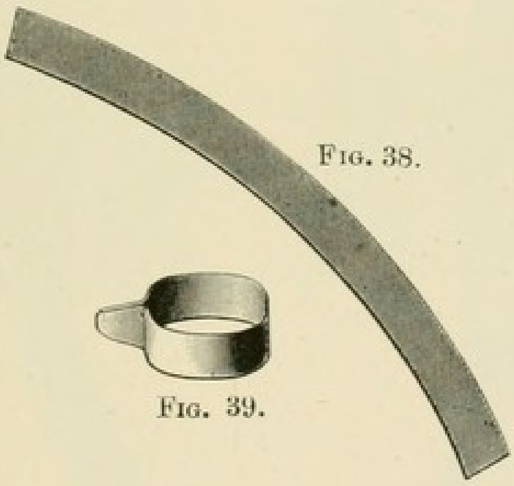


FIG. 38.

FIG. 39.

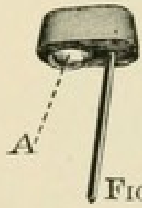


FIG. 37.

flaring top (Fig. 39), by placing the strip about the root to be crowned, grasping the ends with a pair of pliers (Fig. 40) and drawing them together until the lower edge of the strip, which edge alone comes into contact with the root, takes accurately the form of the latter a little under the gum margin. The ferrule is then soldered, trimmed at the lugs, replaced on the tooth (Fig. 41), lightly filled to the edge, but not over it, with wax when so placed (Fig. 42), and an impression is taken in composition. The impression being removed from the mouth, the ferrule, if disturbed, is carefully replaced in position in the impression (Fig. 43) and filled level full with wax which must leave the edge clear. Half an ordinary brass pin is thrust head downwards into the wax towards the buccal side of the ferrule (Fig. 44), and a model is cast in plaster (Fig. 45). Next, the

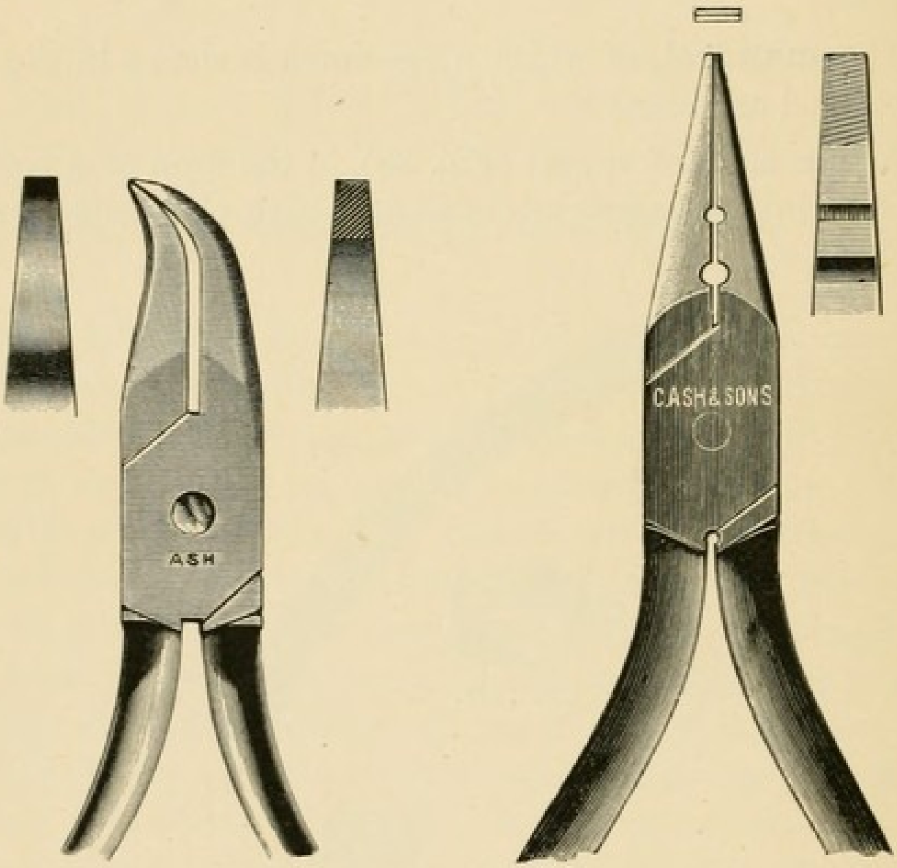


Fig. 40.

ferrule being in position on the model, the wax is removed exposing the pin, and a small depression is cut in the plaster within the ferrule towards its lingual side (Fig. 46) by means of the spade-shaped excavator (Fig. 47). Fusible metal from the cup (Fig. 48), which has been standing in boiling water, is now poured into the ferrule, and a slight pressure is applied with the finger to the cooling metal with the result shown in Fig. 49. This gives us the mandrel (Fig. 37). Should there be any defect in it at the first attempt, the metal may be remelted with the handle of an excavator made hot. It is as well before casting the mandrel to withdraw the pin from the cast and replace it, in order that it may be the more easily removed afterwards. The pin is useful in handling the mandrel, while the pin and the boss (*A*, Fig. 37), corresponding to the depression in

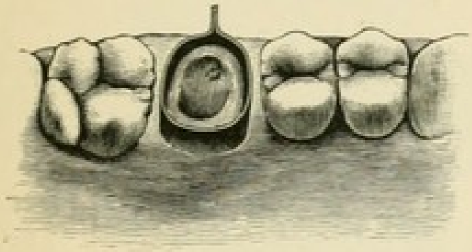


Fig. 41.

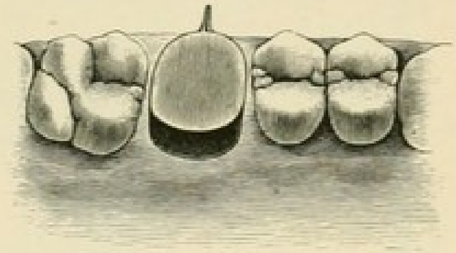


Fig. 42.

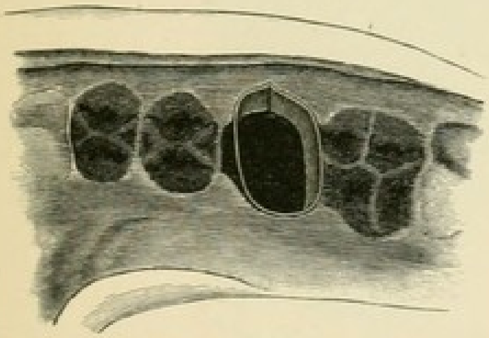


Fig. 43.

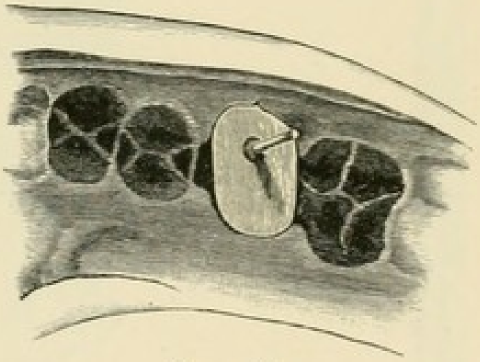


Fig. 44.

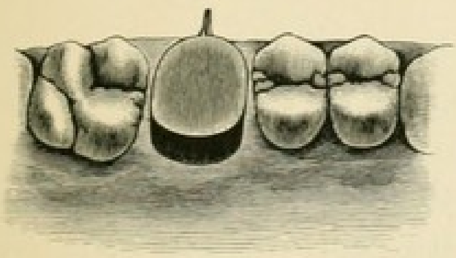


Fig. 45.

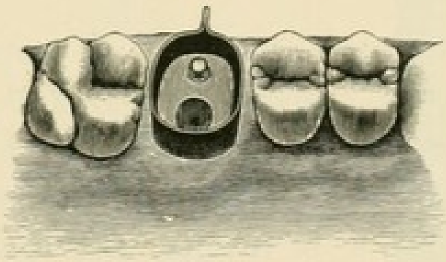


Fig. 46.

the model, together serve as guides in placing it. Figures 50 and 50 *a* show mandrels in position on models, ready for use.

The method of using such a mandrel will be described in the course of the few words I propose to say later on upon Crowning. I will only call attention here to the readiness with which by means of it the depth of the gold collar or ferrule may be determined and the festoon obtained.

Figure 51 shows a method of obtaining a ferrule, such as that shown in Figure 39, of any given dimensions.

Let *OA* represent the least, *OB* the greatest diameter (or girth) of the desired ferrule. At *O*

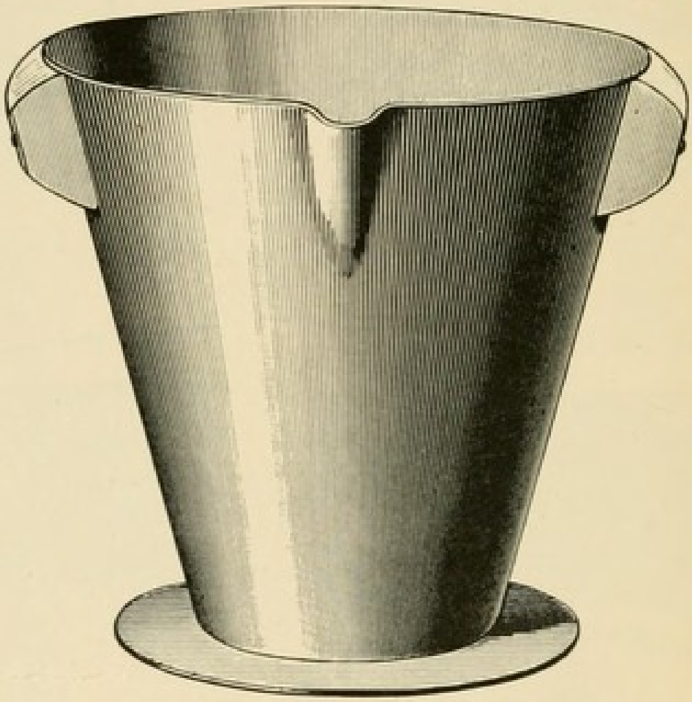


Fig. 48.

and *A* set up perpendiculars to *OA*, and from these mark off *OD* and *AC* equal to the depth of the ferrule required, that is, to the distance between the greatest and the least girth. Draw *BC* and produce it to meet *OE* in *E*. With centre *E* and radii *OE*, *DE*, describe the arcs *OG*, *DF*. Take the arc *OG* equal to the greatest girth of the desired ferrule and join *EG*. The shaded strip *FDOG* will bend up into a ferrule of the given dimensions.

In this way the curvature necessary to adapt a copper strip (Fig. 38) to any given tooth may be ascertained by taking *OA* equal to the girth of the tooth at the gum margin, *OB* equal to its greatest

Fig. 47.

girth, and *OD* equal to the distance between the two girths. It turns out that strips of the curvature shown in Figure 38 are suitable for all ordinary purposes, and we are spared the labour of determining the curvature for each individual tooth.

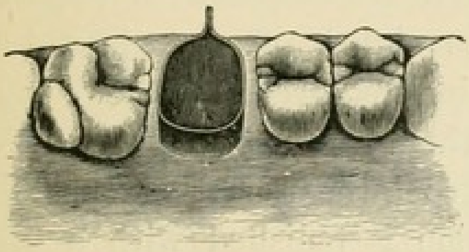


Fig. 49.

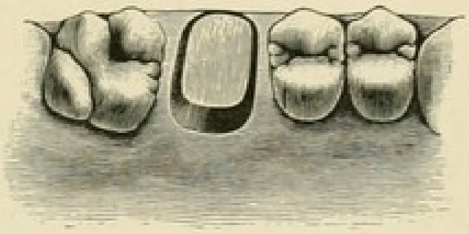


Fig. 50.

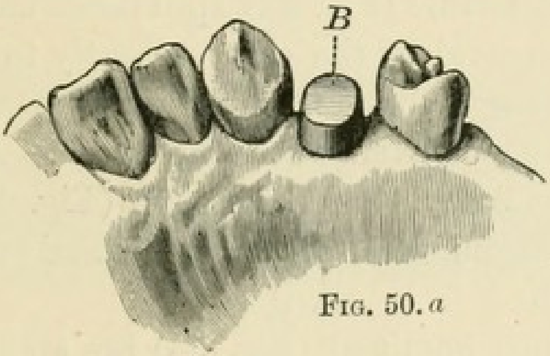


Fig. 50. *a*

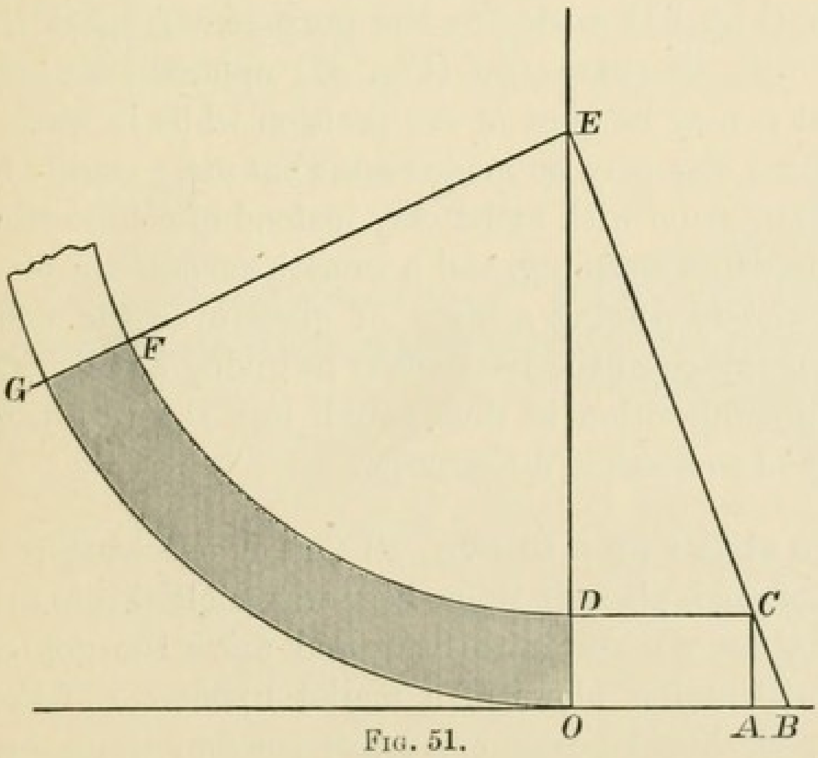


Fig. 51.

I proceed to describe how fusible metal may be used in making **a die for striking up crowns.**

A split ferrule similar to that shown in Fig. 52 has one end closed with a brass cap (Fig. 53) of a size to just close the split of the ferrule, and is filled with composition which is allowed to cool. The exposed end of the composition is again warmed to the depth of about an eighth of an inch, and a natural tooth of the size and kind required is wetted and planted crown downwards into the centre of it (Fig. 53). When the composition is again cool, the tooth is removed, and the surface of the composition is polished with a file and glass-paper, finishing with the back of the paper. The tooth is then slightly warmed and replaced in the composition. A second ferrule (Fig. 52), split down one side to allow of the ready removal of the cast presently to be made in it, is heated and placed wide end downwards upon the composition so as to be co-axial with the tooth. A quantity of fusible metal, melted in the brass cup (Fig. 48) standing in boiling water, is poured into this ferrule and rapidly solidifies about the tooth.

The dies thus obtained (Fig. 54) are all of one size, and may, for convenience of handling, be inserted into the steel punch (Fig. 55) made for the purpose. A mark should be made with the excavator (Fig. 47) upon the side of the die so that it may be kept in one position while in use.

These dies may be made somewhat more readily by filling the first ferrule with moist clay instead of composition. The clay needs no warming, and a smooth surface can be given to it by merely passing a piece of glass over the end of the ferrule. Much of the time spent in giving a polished surface to the composition is thus saved, but the resulting die is hardly of so finished a character.

To strike up a crown, all that is necessary is to wet a piece of gold, place it upon bees-wax melted into and filling the bottom of a vulcanite flask, and drive the gold into the wax with a few blows of a mallet upon one of these dies. The gold should be annealed three or four times during the process. The resulting plate should then be chased upon the die by means of a steel punch so as to render the margin more definite and facilitate the cutting away of the superfluous gold. The punch may be carried in a handle and used

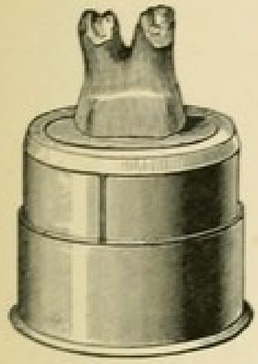


Fig. 53.

Fig. 52.

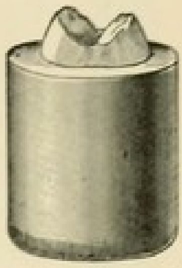


Fig. 54.

C

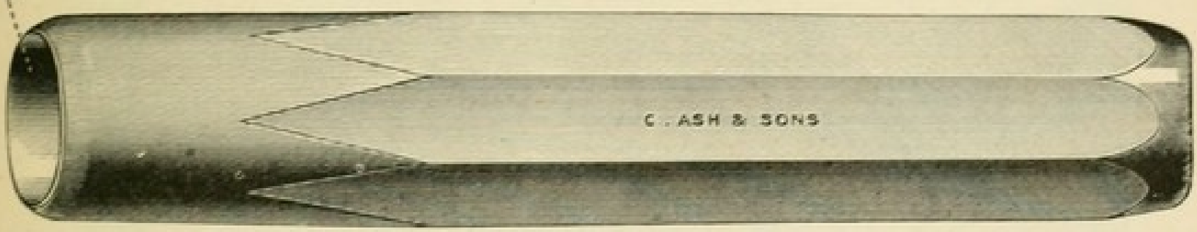


Fig. 55.

as a pressure-punch (Fig. 56), and the die may be most conveniently held during the chasing by taking a piece of board about as thick as the die is deep, and making a hole

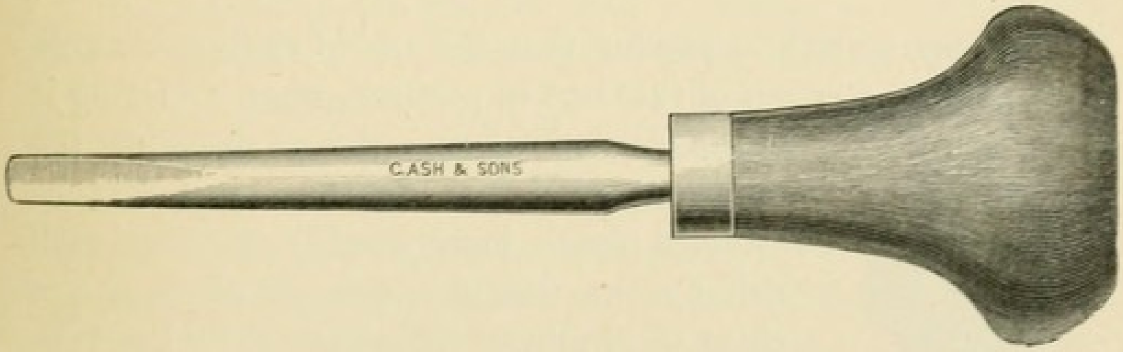


Fig. 56.

through it into which the die will fit accurately (Fig. 57). The hole passing quite through the board, the die may be readily removed from it when its removal is desired, and may be prevented from coming out during the chasing by placing the board upon the bench. Figure 58 is an illustration of the crown obtained by the above process. It remains to cut away the superfluous gold.

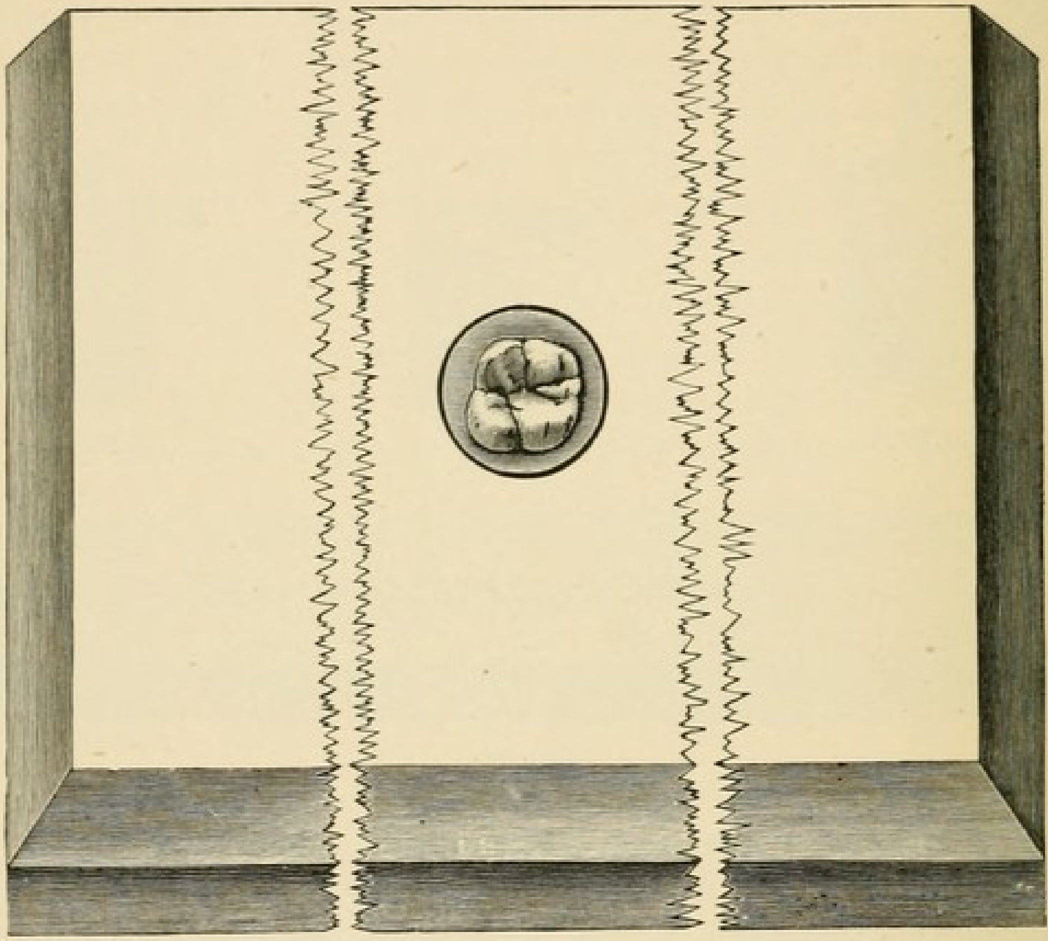


FIG. 57.

I may remark in passing that the use of **spring-clamps** for holding a crown of this sort in position, when soldering it to the collar, involves a risk of dragging the work out of shape, and the object may be attained much more readily without such risk by the use of a pair of pliers and a piece of binding wire, which should not be twisted, but bent only, as shown in Figures 59 and 60.

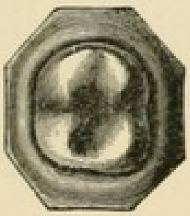


FIG. 58.

The next use of the alloy is to form a **model in pivoting.** An impression is taken in composition by means of the Dowel-Crown appliances described on page 78, by which the direction and depth of the canal are accurately determined; and a cast is taken in fusible metal. This is done by softening and laying into the impression a thin sheet of wax, wetting it, and filling up the impression above the wax with soft composition to form, as it were, a lid. The wax is then removed and fusible metal is poured in between the impression and the lid through an opening arranged for the purpose. The wax should be so adjusted that as little fusible metal as convenient may be used, as large masses of the metal are apt to granulate in cooling.

Fig. 59.

Fig. 60.

The advantages of a cast obtained in this way over one in plaster are that no time is lost in waiting for the cast to set, and the more delicate parts of it, more especially the reproduction of the root canal, are free from liability to injury in working.

It must be admitted, however, that it is sometimes difficult to obtain a satisfactory cast in this way; and the indestructibility of the root-canal, which is after all the chief thing about the cast, can be more readily secured by a method to be described later under Dowel-Crowns.

So much for the uses of fusible metal in crown-work. We come next to the methods of using it in the **repair of vulcanite plates.**

The **first,** it will be seen, is of great use in an emergency, when a patient has had the **misfortune to break out a single tooth** just before he is expected to make an important public speech, or to take part in any of the many public ceremonies in which to appear gap-toothed would be very annoying.

In such a case, I cut a dovetail in the plate exactly as one would cut it if one were going to vulcanise a tooth in; drill two small depressions, one in either edge of the dovetail; secure the tooth temporarily from the front with shellac, and then melt some fusible metal into the dovetail with the handle of the spade-shaped excavator (Fig. 47) made hot. When in a molten state, the metal spheres much as mercury does, and seems unlikely to make a proper fit; but a slight pressure between finger and thumb applied as the metal cools puts matters right, and the expansion which takes place on cooling gives a very tight and secure joint. The whole thing may be done in about five minutes. Where an **additional tooth has to be inserted,** the plate is prepared, and the tooth is set up just as if it were to be vulcanised in.

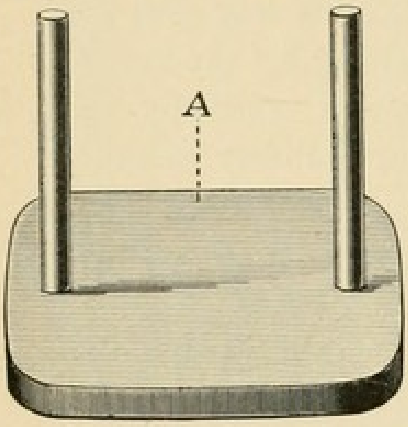


Fig. 61.

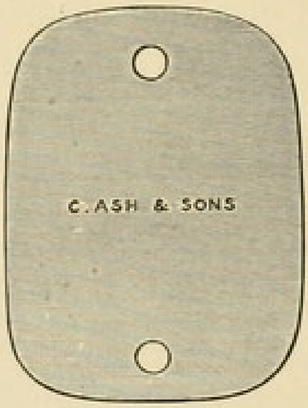


Fig. 62.

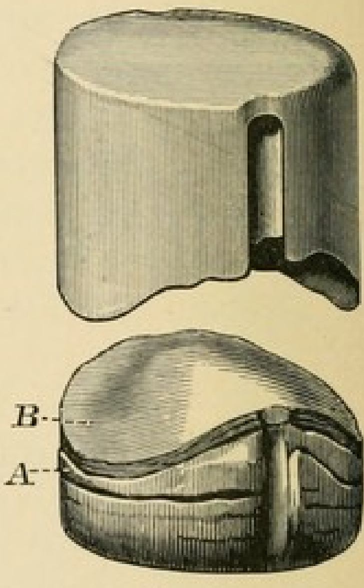


Fig. 63.

It is then invested in plaster, the part where the rubber would be packed being left exposed; the wax is scalded out, and fusible metal is poured in to take its place.

A **second** use for the metal in executing repairs arises when the **vulcanite base has been cracked** and needs to be strengthened with a small gold plate. In this case a wax disc is applied to the vulcanite plate at the part to be repaired, and a cast of this disc in fusible metal is obtained by the same method as that described below for making a trying-in plate (p. 55). This cast is set, face downwards, in a layer of clay on the plate (*A*, Fig. 61); a ferrule of celluloid similar to that shown in Fig. 52 is placed round the posts

(Fig. 61); and fusible metal (*A*, Fig. 63) is poured in to unite with and strengthen the previous cast (*B*, Fig. 63). The face of the die thus obtained (Fig. 63) is then rubbed over with rouge and water; the die is placed, face upwards, between the posts (Fig. 61); and a counterpart is cast by again putting the celluloid ferrule about the posts and pouring fusible metal slowly in till it reaches the tops of the posts. It is advisable to smear a little clay between the celluloid ferrule and the posts before making the casts.

To strike up the gold plate, we first place the washer (Fig. 62) upon the plate (*A*, Fig. 61), then the die face upwards, the gold plate, and the counter die (Fig. 63), in the order named, the washer serving to raise clear of the posts the end of the counter which is to be struck. During the striking up, the posts should be supported by the fingers.

Lastly, there are the three ways in which the metal may be employed in the **manufacture of new plates.**

First, as a base or trying-in plate. This is obtained as follows:—A wax plate is fitted to the usual plaster model and trimmed to the size of the desired metal plate. A piece of wax, about three times as thick as the wax plate and half an inch wide, is attached to the posterior edge of the plate and carried along the centre line of the model to its extremity, and this together with the whole plate, slightly French-chalked, is enveloped, while in position on the model, in a layer of composition about a quarter of an inch thick. The composition being set, the wax plate is removed, and fusible metal is poured in at the orifice left at the heel of the model, between the model and the composition, to take the place of the wax.

The metal plate thus obtained may in some cases be difficult to remove from the model. In ordinary cases, it may be removed with a little humouring, and it does not really matter if the finer parts of the model are damaged in the process, since the plate itself affords the quickest and most practical way of obtaining a duplicate model as good as the original model was at first.

In cases where the model is deeply undercut on the outside, owing to the form of the gum, the wax plate should not be carried into the undercut, or it may be impossible, without much trimming, to remove the metal plate from the model. The latter plate, being removed, is trimmed, where necessary, by going over it with a heated steel rod, such as the handle of an excavator, and is then ready for the teeth.

With a little care a plate may be made in this way which will fit the model, and the mouth too, far better than wax can ever be made to fit them, all the rugae and other peculiarities being reproduced with wonderful distinctness. Such a plate may be trusted not to change shape, and, when it comes to flasking, the plate can be removed even more readily than a wax one. Other advantages attend the use of a plate of this kind. In the first place, the troublesome necessity of making vulcanite trying-in plates is entirely got rid of, and further, as there is no need to dry and dip the models, the metal plate can be made and the bite obtained in a comparatively short time after the impression has been taken, thus saving a patient from a distance one at least of the three journeys which are otherwise often necessary. Lastly, as has been already explained in Chapter I. p. 12, a plate of this kind makes it possible to save the original model without any attendant disadvantage.

I may add that it is **sometimes advisable to use fusible metal to make lower** as well as upper **trying-in plates,** and this is particularly the case where there is likely to be any difficulty in keeping the plate in position when taking the bite, as there may be in some edentulous cases. Otherwise, a lower made with composition is to be preferred, as it is more readily made than a metal plate, and is less likely to be distorted than a wax-plate.

Figure 64 shows a fusible metal upper and a composition lower with the teeth waxed up, and a stay-bar (p. 14) applied, in readiness for flasking.

A small partial plate made of fusible metal by the above method has been found useful for actual wear in an emergency, when there has not been time to make a vulcanite plate.

A **second** and not less important use for fusible metal in making new plates lies in employing it to make a **slab articulator.**

Most people are no doubt familiar with the old slab-bite, and probably most have discarded it for some of the modern and more elaborate articulators. To some of the objections to these I have already referred (p. 8), and I will only add here that further difficulties arise from their use when a zinc is to be cast. But the plaster slab has also its disadvantages, the chief of which is the loss of time involved in drying and

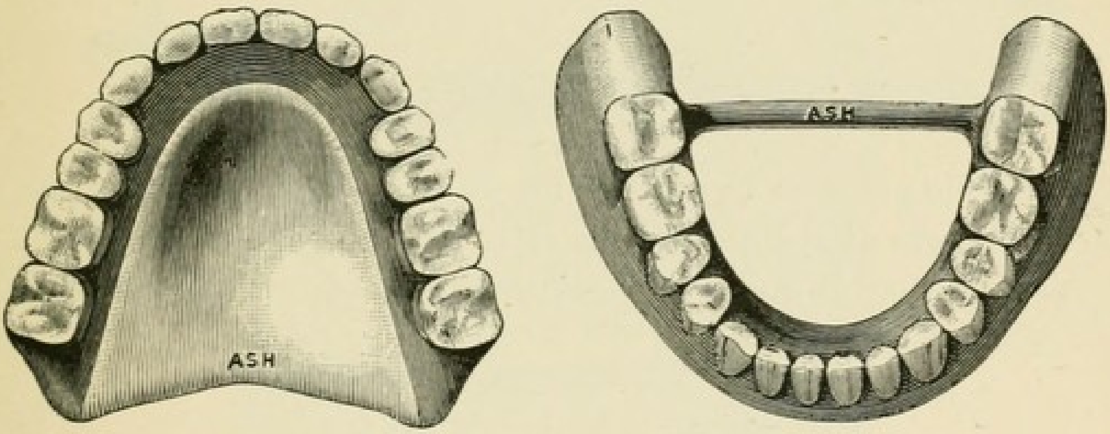
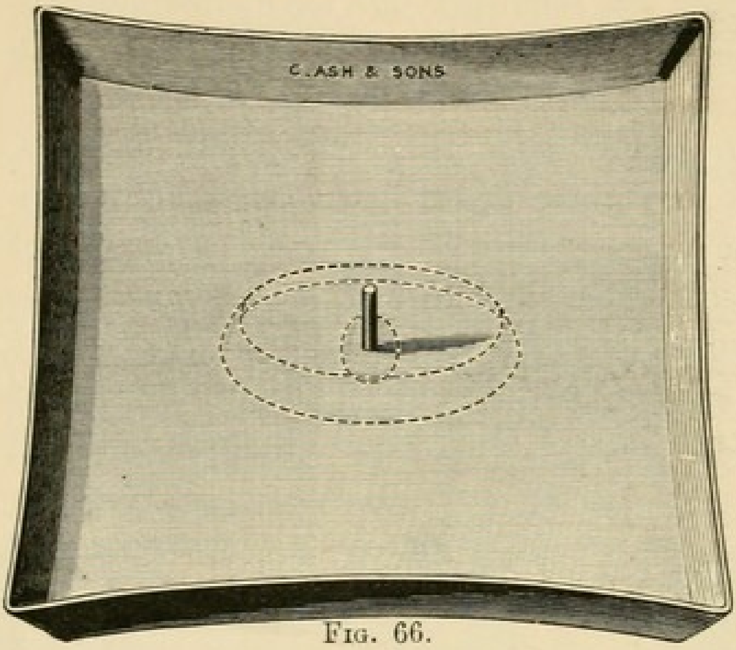


FIG. 64.

dipping the models and waiting for the slab to set. By the use of metal instead of plaster this also may be got rid of.

To make a fusible metal slab, the models having been so trimmed that the small tray (Fig. 65) will pass between them when in the position given by the bite, this tray is so adjusted about the post in the centre of the larger tray (Fig. 66) that the models with the small tray between them will sit comfortably in the larger tray. The small tray being fixed in this position by means of the split tube and disc (Fig. 67), fusible metal is melted in the larger tray by placing it in a shallow pan of boiling water; the boiling water is then poured away and the models, held in the position given by the bite, are dipped into the molten metal and held there till the metal is cold, its cooling being accelerated by pouring cold water into the pan up to the level of the edge of the tray.



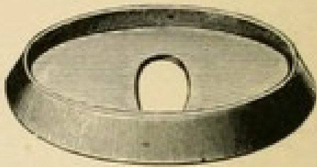


Fig. 65.

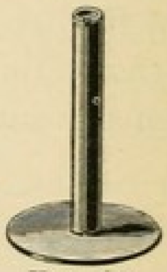


Fig. 67.

Fig. 66.

This gives us a perforated metal slab (Figs. 68, 69) of the same form as the old plaster slab, but the position of correct articulation is much more sharply defined in the metal slab

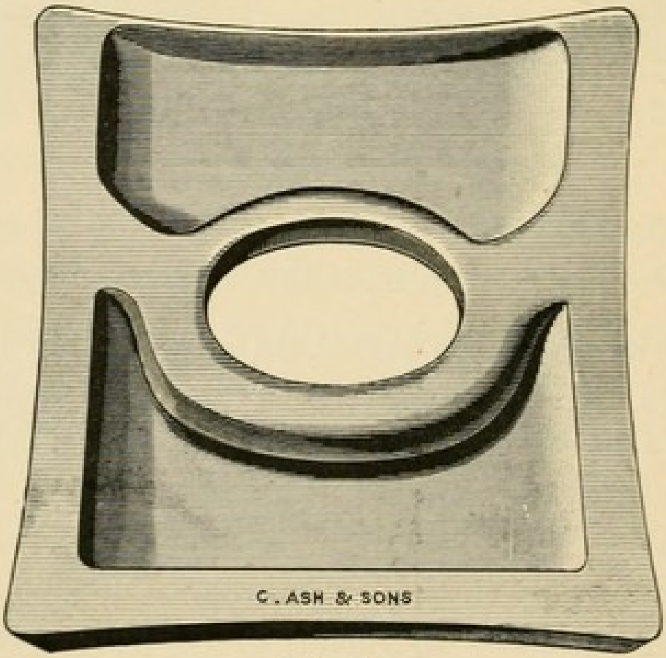


Fig. 68.

than in the other; the metal slab sets with great rapidity, and, no drying or dipping of the models being necessary, much time is saved.

In cases where the upper plate is to be of gold, and the lower of vulcanite, the upper model has to be shaped and dried to facilitate the casting of the zinc. But the lower model need not be dried, and can therefore be readily trimmed so as to line with the upper model and enable the pair to sit comfortably in the bite-tray (Fig. 66).

A word or two may be usefully said as to the method of **removing the slab from the trays.** As the metal by expanding when cooling takes a grip of the small tray, it is

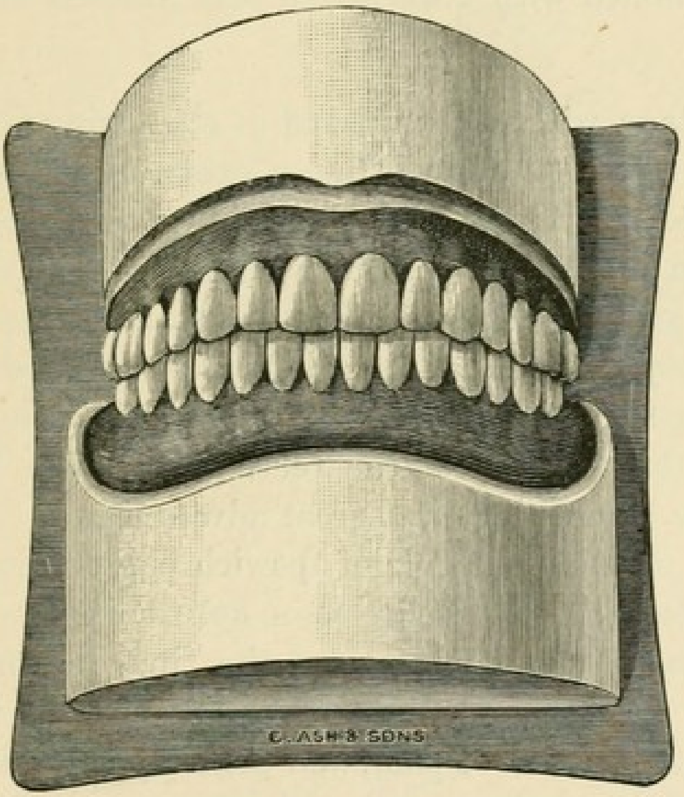


Fig. 69.

necessary first to remove the split tube and disc, then to clear the slab of the larger tray, and lastly to push out the smaller tray from its centre.

The expansion of the metal must also be taken into account when trimming the models, or it will be impossible to remove them from the slab after it is set. Again, care must be taken that the models are long enough to keep the base-plate clear of the metal in the tray.

With these simple precautions everything will go smoothly, and a good slab will be obtained in a very few minutes.

Another use for fusible metal lies in **filling up the interstices between tube-teeth in a gold bar lower,** the purpose, of course, being the prevention of accumulations between the teeth.

This is done by placing composition along the outer sides of the teeth and pouring fusible metal into the interstices on the inner side. The composition being removed, the metal may be trimmed with a warm rod and finished in the usual way.

Advantage will also be found in employing the metal to make a **model for correcting a metal plate which has been accidentally bent;** and again, to give the **articulation when setting up teeth** for a case where all the teeth in the other jaw are still standing. In this last case, however, it is not easy to get a cast in which the teeth are as definite as in a plaster model, though, if a good metal cast be once obtained, the freedom of the teeth on it from liability to abrasion or other injury is a great advantage.

Lastly, as Mr Fenn Cole of Ipswich pointed out, a fusible metal plate may be useful as a **splint** in the case of a fractured jaw. The shortness of the time in which such a splint can be prepared is a very great advantage, relieving the patient of hours of pain, and enabling full advantage to be taken of the tendency to heal by first intention.

While on the subject of splints, I may point out that a fusible metal or a vulcanite **splint may be secured in position,** when sufficient teeth are standing, by drilling holes through the plate in two places in such a way that tapering wires passing through them will pass between adjacent teeth and hold the plate down.

Of course, in making such a splint, the crowns of all the teeth should be allowed to come through and antagonize with the uppers.

It is to be regretted that surgeons in general do not seem sufficiently aware of the **advantage to be derived from sending early for a dentist** in a case of fractured jaw, and from calling one in **beforehand** when an operation for epithelioma is to be performed.

CHAPTER IV.

MATRICES: HOW TO MAKE THEM AND HOW TO APPLY THEM.

THE following is an extract from a paper read at the Annual Meeting of the British Dental Association at Newcastle in the spring of 1894.

"When the meeting of the Association was last held in London (1891), in the course of a paper which I had the honour of presenting to you on fusible metal, I described incidentally a method of making a matrix for one of the purposes I then had in view. The form of the matrix then described was obviously one capable of much wider application, but, as I had been used to it from my earliest years as a dentist, I did not then think it necessary to dwell upon it.

Observing, however, that the several depôts continue to advertise matrices of an almost endless variety of form, among which this particular form never occurs, I have come to the conclusion that it will be useful to insist a little more strongly on the advantages attending the form of matrix I am about to advocate.

I have in my hand a large model of an upper bicuspid to which I have applied a band in the form we would all like a matrix to take when applied to an actual tooth (Fig. 70). This band I will now remove and flatten out, so that we may see what form such a band takes when so treated. It will be interesting to compare it (Fig. 71) with the forms advertised, and I have had a few of the latter (Fig. 72) drawn on this sheet for the purpose of comparison. You will see that what

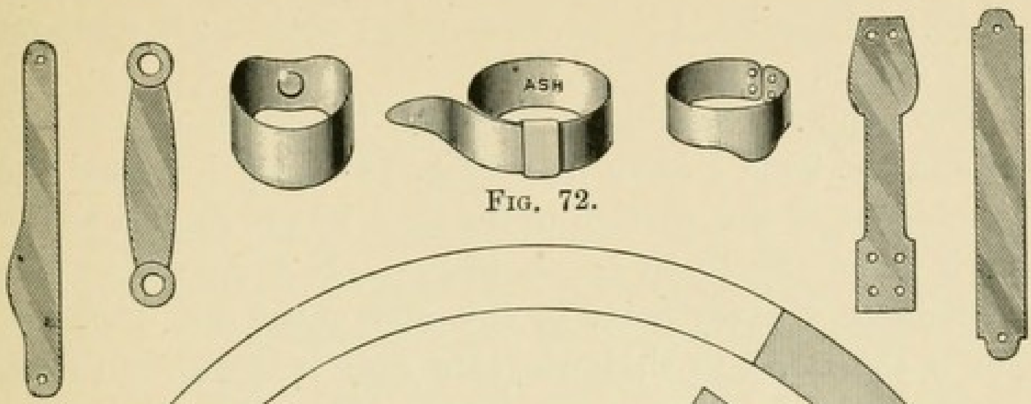


Fig. 72.

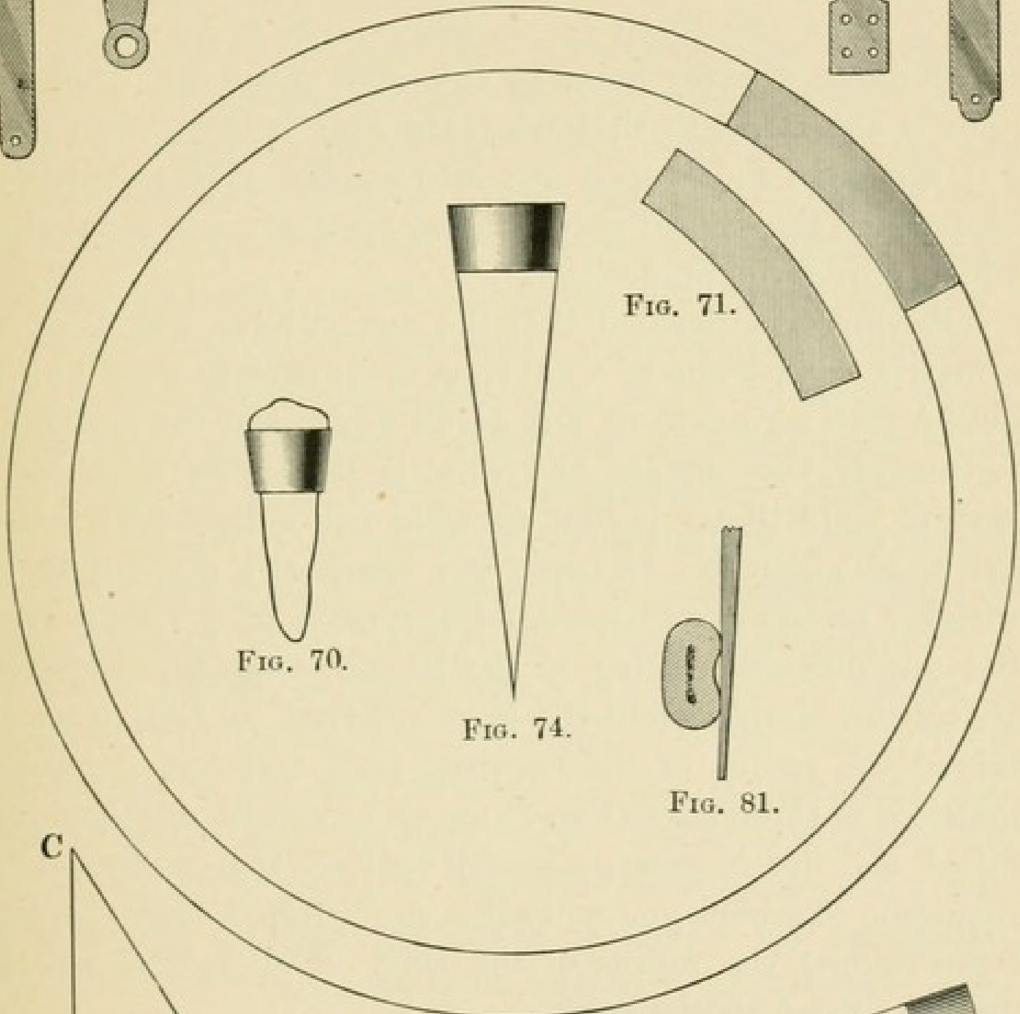


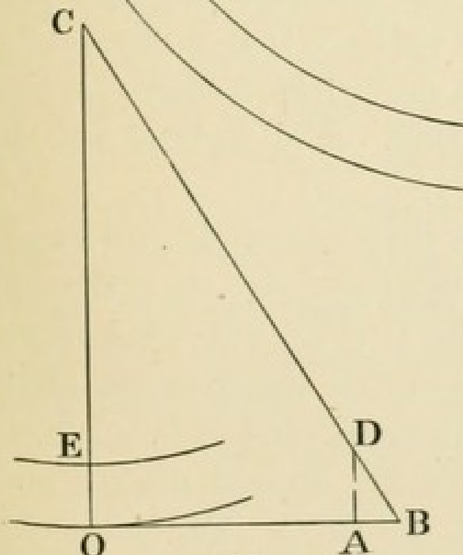
Fig. 71.

Fig. 70.

Fig. 74.

Fig. 81.

Fig. 73.



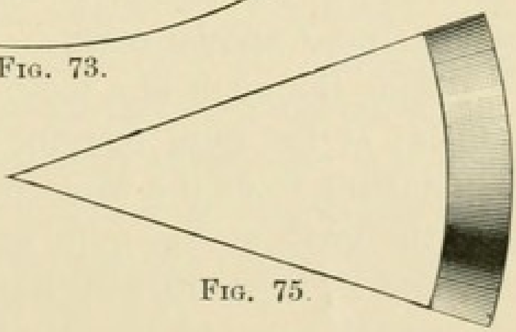


Fig. 75.

Fig. 77.

I think I may now call the correct form (Fig. 71) is practically a portion of a flat ring, such as this (Fig. 73), and there will be no difficulty, I think, in showing that this is what we might expect.

The general resemblance between the tooth-model (Fig. 70) and the cone I have here (Fig. 74) is obvious, and the resemblance of the portion of the cone I have shaded to the matrix upon the tooth is not less so. Now it is clear that the distance of every point in the edge of the cone from the apex is the same, so that when the cone is opened out (Fig. 75), the edge must open out into a circle with the apex as centre, and the shaded portion must open out into a flat ring, which proves the proposition.

Having now decided that the correct form, may I say, of a matrix is a portion of a flat ring, it remains to show how to obtain such a ring to fit any given tooth, and the method is fortunately very simple, and what is still more fortunate, I suspect you will say, is that we need not individually bother our heads about it. It turns out practically that all teeth, whether molars or bicuspids, require parts of the same ring, the only difference being in the length of the part required. Using the simple method I have referred to, I have ascertained the radius of the required ring, and have prepared matrices of three sizes (Fig. 76), such as can be readily reproduced, and are in practice pretty well all that will ever be required. Perhaps you will allow me briefly to describe how I ascertained the radius of the ring. The method will be useful to meet special cases.

Taking the girth of a tooth at its greatest circumference, and also at the gum margin, I set these out on a straight line, starting from the same point O (Fig. 77). OA represents the girth at the gum margin, OB the greatest girth. At O and A, I set up perpendiculars OC and AD. I made AD and OE equal to the depth of the desired matrix, and, joining BD, produced it to meet OC in C. The point C is the centre from which, with radii CO and CE, circles can be described which will give the desired ring.

With the proof of this I need not trouble you, but one other point with regard to the form of the matrix remains to be noticed, and that is, the form of the ends which are to come together when the portion of a flat ring which we have now obtained is bent up to form the matrix, which is itself, as we have seen, practically a portion of a conical surface (Fig. 70).

Returning for a moment to our cone, we see that the meeting edges are straight lines running through the apex of the cone, so that these straight lines, when the cone is opened out (Fig. 75), are radii of the circles which give us the flat ring. If, then, the portion of a flat ring (Fig. 71), when bent up, is to give us a matrix of the desired conical shape (Fig. 70), its ends must be radii of the circles forming the ring.

I come now to the method of applying such a matrix to a tooth, and I have endeavoured to devise a clamp which should meet requirements—with what success I must leave you to judge. This clamp, or double-acting parallel vice (Fig. 78), which is the result of my endeavours, and which I have now the honour to introduce to your notice, requires some additions to the portion of a ring, which constitutes the matrix proper, for the purpose of securing the matrix to the clamp. I will call these additional portions 'lugs.' With these additions the strip to form the matrix takes this final shape (Figs. 76, 79). In applying a matrix to a clamp, the ends of the strip are to be inserted one after the other into the slots (Fig. 78) provided for the purpose in the clamp, and bent up along the radial lines before described, each strip having one or two such radial lines (Fig. 76) marked upon each end to ensure its being bent in the right direction. The purpose of having more than one mark at each end is to allow of the ready adjustment of the length to the particular tooth to be dealt with. For tightening the clamp we need a flexible key such as this (Fig. 80).

I find I am running into rather more time than I anticipated, but there are still one or two more rather important points which, with your kind permission, I should like to touch upon.

We often find it recommended that, when a matrix is applied to a tooth, its lower margin should be forced up into close contact with the tooth by means of a wedge. This is, of course, impossible when there is no adjacent tooth to wedge against, and when the cavity extends beyond the gum margin; but I hope to show that it is equally impossible in many cases, even when there is an adjacent tooth, and when the cavity does not extend beyond the gum margin.

Every one is aware of the grooves generally to be found running down the sides of a root, especially the sides of upper bicuspids, and will recognise at once the impossibility of forcing the matrix into such a groove by means of a wedge. I have had my model made in sections so as to be able to illustrate this difficulty, and have but to apply this rod, representing a wedge, to the section (Fig. 81) to make my meaning clear. Some method of meeting this difficulty is desirable, and I venture to propose this.

I have had made a mandrel or shaping-tool (Fig. 82) in the form of a double cone, one end corresponding to the cone formed by a matrix for an average molar, and the other by a matrix for an average bicuspid. This is in practice all that is required. Down the sides of the mandrel I have had grooves cut to correspond to the grooves in teeth. This is how I use the mandrel. The 'lugs' of a matrix having been inserted into the slots in a clamp, I slip the matrix on to a mandrel, and with a hammer tap it into a symmetrical shape (Fig. 79). If the matrix be now withdrawn from the mandrel, it will be found securely fixed into the clamp, and capable of being carried any distance to the mouth without risk of its falling out. But before withdrawing the matrix from the mandrel, I force its lower margin into the groove in the mandrel. On applying a matrix so bent to a tooth, I find that the bent portion forces itself into the groove in the tooth, should one exist, and is not drawn out when the clamp is screwed up; whereas, should no groove happen to exist in the tooth, the bent portion of the matrix is drawn out, and the matrix in any case takes accurately the form of the root to which it is applied. Moreover, owing to its conical shape, the matrix, on being clamped up, naturally works its way under

Fig. 78.

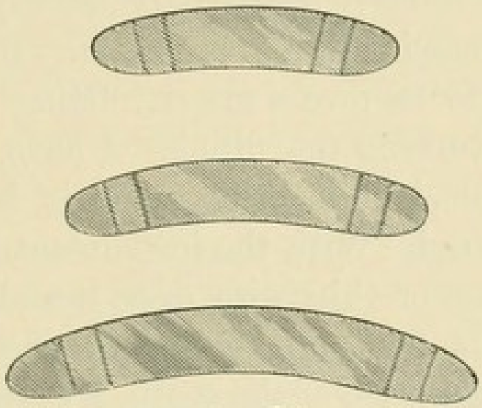


Fig. 76.

Fig. 79.

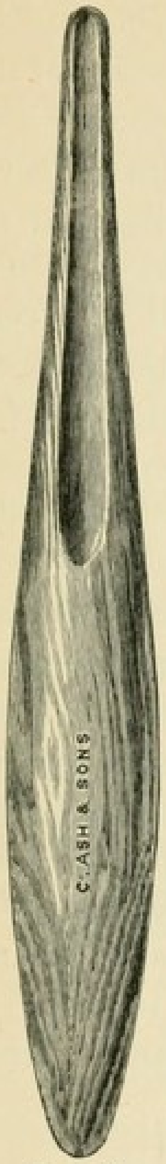


Fig. 82.

Fig. 80.

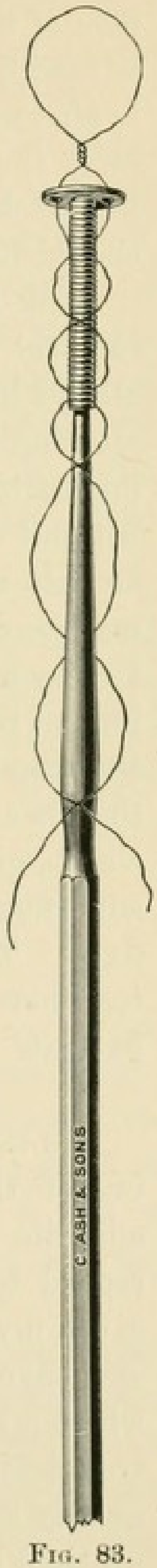


Fig. 83.

the gum, and this process may be promoted, if desired, by trimming the lugs. The matrix once in position, the compactness of the clamp allows the rubber-dam to be applied almost as readily as to the teeth alone, and the presence of the clamp is afterwards a positive advantage to the operator by keeping away the rubber-dam, and so affording him a clear view of his work. I may suggest that in applying the rubber it should be put first over the clamp and then over the tooth.

The last point to which I wish to call attention is the removal of such a matrix, and here I would urge that it is always best to leave a matrix on, at any rate for a few hours, after an amalgam filling is put in. Indeed, it is sometimes impossible to remove a matrix, fitting as I have described, without disturbing the filling. I have, therefore, to suggest an easy method of securing a matrix in position as long as may be desired. With the instrument I have here (Fig. 83), I carry a loop of thin wire over the clamp and behind the lugs of the matrix, and, holding the instrument so as to close the loop lengthwise of the tooth, I twist the ends of the wire together by a few turns of the carrier, partly remove the clamp, give a few final turns to the wire, cut off what is superfluous, press the lugs to the tooth, and the matrix is fixed. To remove it, we have simply to draw the lugs together and slip off the loop, and this can be done by the patient."

To this in the summer of 1894 when addressing a meeting of the Irish Branch of the Association I was able to add the following: "I should like to say a few words with regard to a class of cases in practice which have hitherto given my partner and, I have no doubt, others some trouble, and have been a source of no little pain to patients, but for which a remedy has lately presented itself. I refer to those troublesome **cases in which the gum has crept into a cavity** and covers an otherwise exposed pulp. I need not take up time by describing how we have hitherto dealt with such cases, but will proceed at once to describe our new method. It is very simple. We take one of the matrices I had the honour to describe to the General Meeting of the Association at Newcastle, and, having carbolised the gum, we apply the matrix to the tooth. The form of the matrix is such that it conforms to the shape of the tooth from the moment the edge first presented to the tooth has passed the crown. It follows that when the matrix is tightened up by means of the clamp, it works its way along the tooth and strangulates the intrusive portion of gum, practically cutting it off, without, however, any discharge of blood. The portion of gum filling the cavity can then be removed, and all this without pain to the patient. The matrices are gilded and can therefore be left on without ill effect, thus enabling the operator to apply his dressing for the devitalisation of the pulp and to secure it in position by means of any of the temporary fillings."

A word or two must be added about **the clamp and the method of putting one together.** Experience has shown that it is necessary to warn those who may use these clamps that they are furnished with a **double screw**

FIG. 84.

(Fig. 84), the screw at the screw-head or square end being left-handed, that at the other right-handed. One consequence of this is that, if taken to pieces the instruments are puzzling to put together again, and some who have essayed putting them together have ruined the clamp by trying to force an end of the screw into a chop for which it was not intended, thereby breaking up the threads.

A few hints may save this trouble. Begin by removing the slide-bar, if not already removed, from the chop into which it is screwed. Then, using the screw-head in the ordinary way, that is, by giving it turns clockwise from left to right, screw the opposite end into the flat side of the chop in which the slide-bar was originally fixed, until the chop reaches the middle of the screw, where it will stop naturally, if no violence be used. Then slip the other chop, flat-side foremost over the screw-head and spin it round the screw counter-clockwise from right to left. When the two chops have met, flat sides together, in the middle of the screw, pass the slide-bar through the chop nearest to the screw-head and screw it in the ordinary way into the other. The clamp will then be ready for use.

In no case whatever should a screw be forced through a chop, since when chops and screws are brought together in the right way, everything works with the greatest ease.

There are also **one or two hints with regard to the matrix** which may be useful.

The **first** of these is that, while something is to be gained by **trimming the lugs of the matrix,** as already explained, it is futile, as well as needless, to cut them so that there is a large prominence on the shorter margin of the matrix in order to meet the case of a deep cervical cavity. Such a prominence escapes the strain exerted by the clamp when tightened, and consequently curls away from the tooth, thereby allowing the filling to be pushed through and sacrificing the effect for which the matrix is designed. It should be remembered that the matrix naturally works its way along the tooth as the clamp is tightened. When this has to be carried to an extent which causes pain in the gum, some relief may be afforded without seriously affecting the utility of the matrix by slightly straightening the lower margin, that is, by cutting off a strip, narrow near the 'lugs' and narrowing off to nothing before the middle of the matrix is reached. This may be done at one or both ends of the matrix.

When a difficulty arises in putting on a **matrix between closely adjacent teeth**, room may be secured by forcing a piece of hard steel tape, rather thicker than the matrix to be used, between the teeth and leaving it there for a minute or two.

Again, **deep cervical cavities** are sometimes **difficult to prepare without wounding the gum.** In such cases a matrix may be loosely applied before beginning to work at the deepest part of the cavity, and it will then be impossible to damage the gum during the work.

These hints are the outcome of my partner's experience in the use of the matrix; and to him is also due, as I gladly take this opportunity of acknowledging, the stimulus that has led me to attempt much that is here recorded.

CHAPTER V.

CROWN AND BRIDGEWORK.

Some seven years have now elapsed since, at the meeting of the Association at Exeter, I ventured to take part in what was, I fear, an abortive discussion upon this subject, abortive because almost entirely devoid of those statistics which alone could enable us to form a judgment as to the utility of the many fantastic devices put forward in the text-books under the name of **Bridgework.** Dr Melotte did indeed on that occasion talk of two successes, one of seven years' standing and another of four, but also spoke of many mishaps with his bridges; while Dr Barrett supplied a stream of cold water.

At that time I had had but little practical experience of bridgework, and I have had none since, nor shall I ever have any, until some of its enthusiastic advocates are good enough to show me not merely how a bridge may be applied in any given case—anyone of a fairly mechanical turn of mind could do that abundantly; it is done to excess already in some of the text-books,—but also that the bridges so applied have any life worth considering before them, and are really beneficial and not harmful to the patient.

A priori reasoning is certainly all against bridgework, of which the fundamental concern is how to make one or two roots do the work of three or more; how to make an instrument, which is by nature intended to endure in the main a longitudinal pressure, endure an unnatural lateral thrust or drag. In the most favourable case, this does but affect roots which would in any event have to be crowned, and the damage, which in my belief always results, sooner rather than later, only amounts in this case to the loss of such roots. But in many cases, if we are to credit what we read, natural crowns, which could with a little filling be readily made good and so remain useful for years, have the lugs of a bridge embedded in their fillings, and forthwith the trouble begins. If, in spite of a stress upon it which it is ill-calculated to withstand, the filling holds its ground, there ensues, under the pressure of mastication, a thrust or drag upon the root and its socket for which they were never intended, and with a result that need not be described. If, on the other hand, as is more likely, the filling gives way, decay is renewed in the tooth, and in either case the end is the same, the loss not only of the bridge but also of the tooth.

In the worst case of all, a sound natural tooth is hacked to receive a lug, or trimmed out of all recognition to receive a cap upon which to fasten a contrivance in its nature destined to create unrest and destruction. It is an axiom with builders that an arch never sleeps.

All this is avowedly but *a priori* reasoning, and experience may, of course, have proved it, as it so often does prove such reasoning, utterly unfounded, but, if it has done so, we may reasonably ask those who have had the experience to demonstrate it to us by giving us a full account as well of their failures as of their successes, so that by comparing the one with the other we may be able to judge of the probability that the like success is possible for us. Meanwhile I am satisfied that I can do better for my patients with a plate than with the least ambitious piece of bridgework.

But having called thus loudly for **statistics,** it is right that I should contribute such as I can. At Brighton in 1889, my partner and I demonstrated a method of inserting a bridge supplying the four upper incisors and supported upon the two lateral roots. The method was far from being as simple as with the appliances I now possess it might readily be made, and I should not adopt that method again. Subsequently we inserted an exactly similar bridge on the same plan. The second bridge after six months' wear was knocked out by the handle of a mangle and is therefore only interesting, from the statistical point of view, in this, that the patient declared she liked the bridge and was sorry to lose it. But the first bridge failed, and failed not, I venture to say, from the method of insertion, but from the nature of the case. For the failure arose from a movement of the roots, whereby the bridge was made to protrude. In other words, the two roots failed to support a lateral strain which was properly the work of four. No one will suppose for a moment that we were foolish enough to bring this about by allowing the lower teeth to strike the bridge, but it may perhaps be urged that wires passing from the bridge round the canines would have called in the aid of two additional roots, to which I can only reply that it would but have delayed the result while extending the area of the mischief. We have since seen a bridge, the work of others, fail in precisely the same way. It is needless to say that we do not now advocate the application of a bridge in such a position, whether on the plan then described or any other, and yet here, if anywhere, one would have said most was to be hoped from a bridge.

But if bridgework is, as I think, in such dubious case, it is quite otherwise with **Crown-work,** by which many a feeble root, which awhile ago would have been regarded as past hope, is now saved and made useful for years. But, while the utility of crown-work is beyond dispute, the principles upon which it should be carried out are much discussed, and the methods actually adopted are of almost endless variety. This is, no doubt, partly because individual cases suggest and even demand special treatment, but more especially because there is so little opportunity of comparing the actual working and results of the several methods advocated.

In these circumstances, I will venture in the first place to make a few remarks upon such of the **methods and systems of crowning** as are known to me, and then proceed to describe the plans which my partner and myself, while prepared at all times to admit variations to meet individual cases, now generally pursue.

Among the devices which appear to me quite unnecessary is that of the **feathered post,** intended to prevent the possible rotation of the crown. Any device which calls for a considerable enlargement of the canal is proportionately objectionable, and the risk of rotation is obviated, without any enlargement, by simply cutting down the anterior edge of the root somewhat farther than the posterior edge, so that the surface of the root in contact with the crown is not strictly plane. If this be done, so long as the post is fixed longitudinally, rotation is impossible; while, if the post becomes loose, the result is a failure, whether the post be feathered or not.

Another method which I never adopt is that with a **tube and a split pin,** and this for the reason that, the split pin being removable, foreign matter finds it way into the tube, decomposes, and becomes offensive.

Of the systems familiar to us by name, the **Bonwill** is faulty in that it leaves an opening by which the cement with which the crown is fixed is exposed to the fluids of the mouth, and, moreover, the amount of grinding of which the crown admits is strictly limited and the crown is, therefore, not applicable in shallow bites.

The **Logan,** having a fixed post, admits of but little grinding and shortening, and therefore necessitates the possession of a large stock to meet the variety of cases or compels the undue shortening of the root. Moreover, again because the post is fixed in the crown, the root must be 'thimbled' out to receive it; cement must be used; the crown is consequently all but irremovable, and in the event of a fracture the root is lost. Moreover to stand the firing which is necessary when baking the tooth, the post must be made of some hard platinum alloy, a costly material which is quite uncalled for when the post is fixed in the crown after the crown has been ground to the root.

The **banded Logan** adds to these disadvantages the faults of a Richmond and moreover it shows the gold.

In a **Richmond crown,** the band determines the direction in which the crown and therefore the post fixed in it must move when being applied to the root, and the canal must therefore be reamed out to admit the post in the direction fixed by the band.

The **Büttner method** carries all the faults of the Richmond to extremes, involving the cutting up of tooth substance to an extent that is never justifiable and is often impossible, and leaving besides some of the cut surface exposed.

Before going on to describe the general practice of my partner and myself in crowning, I may mention that we have found advantage in the **case of very feeble anterior roots** in simply capping and banding them with gold, using no post, but trusting wholly and successfully to cement and to accuracy in fitting the band to a model obtained as hereafter described. In another case, my partner having built up a **very poor bicuspid root** with amalgam, I made a cap and band upon which I mounted a tube-tooth, and again fixed the crown on the root without the use of a post, trusting as before to accuracy of fit.

Lastly, I may refer those who are interested in the **history** of such matters to page 495 of the Journal of the British Dental Association for 1889 and to page 475 of that for 1890, where they will find accounts of the methods which I then pursued, but which I merely mention here in order formally to discard them, having superseded them, I hope rightly, by the methods presently to be described. Amid all changes, however, I have always endeavoured to be faithful to one aim, and that is to avoid working at the mouth, whenever possible. One result of this is the paper which immediately follows, and which was read at the Annual Meeting of the Association at Edinburgh in 1895.

"On a Method of obtaining a Plaster Model as good as the Mouth with a view to Crowning one or more of the Anterior Teeth.

I have at all times been anxious, as I have no doubt everyone, whether practitioner or patient, has been anxious, that the work to be done at the mouth should be reduced to a minimum, and I wish now to explain a method whereby this is, I think, attained in cases where one or more anterior teeth are to be crowned.

What has hitherto induced many to work entirely at the mouth in crowning has been the difficulty, if not the impossibility, of getting a definite impression of the root-face by the ordinary means. The distance between the neighbouring teeth at the gum margin being greater than that between them at their cutting edges, there is always a certain amount of dragging which obliterates the impression of the root-face.

This difficulty I am now prepared to meet by a method which, besides furnishing definite impressions of the root-faces, will give in the same impression the height of the neighbouring teeth, natural or artificial, the different directions of any number of root canals, and as many metal-lined canals in the model, the metal being intended to render the canals incapable of injury in the process of fitting the posts.

To-morrow my partner and I propose to demonstrate this method upon a living but, save for the purpose of crowning, a useless tooth. I will here briefly describe how we shall proceed. We shall first remove the crown by means of a saw—and I should like to take this opportunity of remarking that the excising forceps ought to be regarded in cases of crowning as the key now is in cases of extraction. Having removed the pulp and sealed the apex of the root, we trim the root-face to a convex form by cutting down the edges all round, and open up the root-canal for the post. At this point we find it most convenient to take the depth of the canal with a post and slide or root-sound (Fig. 85), which can then be laid aside for after use. We next proceed to take the impression, and I have now to introduce my first novelty in the shape of a small cap of this form (Fig. 86). This cap we fill with composition, pass a post (Fig. 87) through the middle,

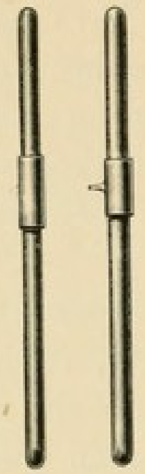


Fig. 85.

Fig. 86.

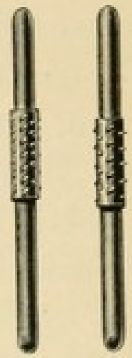


Fig. 87.

and cool. Then heating the surface only, which has been shaped into a mound about the post, as here shown (Fig. 88), we apply it to the root-face, first passing the post into the canal. The effect of the cap and of the mounded form of the composition is to force away the gum from the root-face and give a sharp impression inside the cap, which may be almost instantly cooled by means of a syringeful of cold water. We now remove the cap and post, trim off the composition which is outside the cap, replace the post and cap on the root, and, having wetted the neighbouring teeth, take an impression with my second novelty—a tray with a slot running round the bottom at its outer edge (as shown in Fig. 89 or Fig. 90). In doing this the post is made to strike the centre of the composition, and is directed towards the front of the tray, which then guides it through the slot. We now cool the impression with a syringe as before—it can be done in a minute—remove the post and then the impression. The cap is found sitting in the impression, the edge of the metal only being visible. We are now ready to cast the model. We replace the post and fix it with wax applied to

Fig. 88.

the tray, having first fitted on the end of the post which is to enter the cast a short, roughened, copper tube with an open seam (see Fig. 91). When the model is cast and the

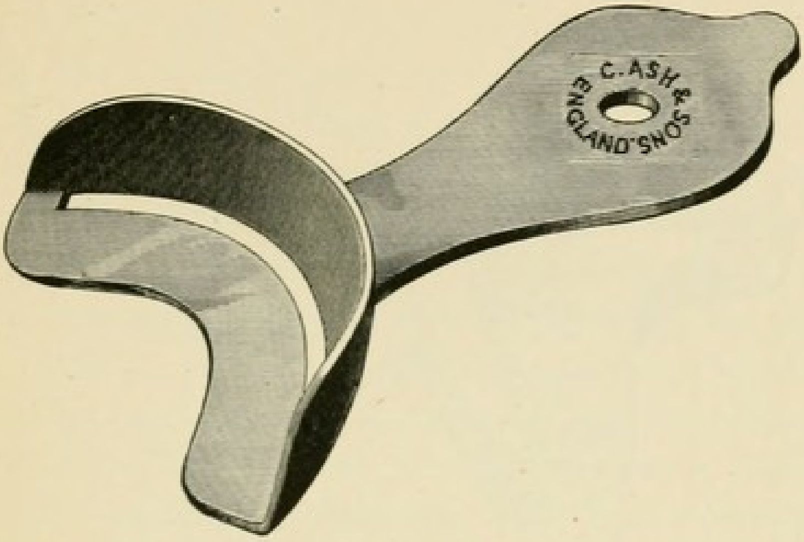


Fig. 89.

post withdrawn, this tube is left behind in the model, and forms the indestructible root-canal before referred to (shown at *A*, Fig. 92). The model is, of course, dried and dipped in stearine.

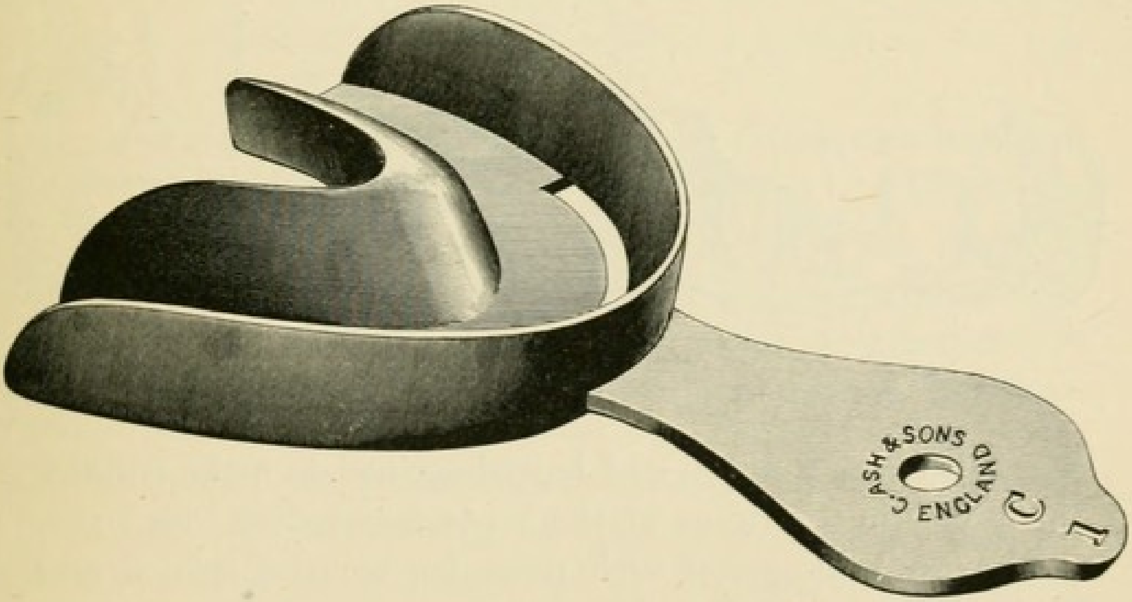


Fig. 90.

This, gentlemen, completes the description I wished to offer you. You will have seen that the small cap not only secures a sharp impression of the root-face, but preserves it from all risk of dragging, while the slot in the tray, if this be properly chosen for the arch, will admit any number of posts

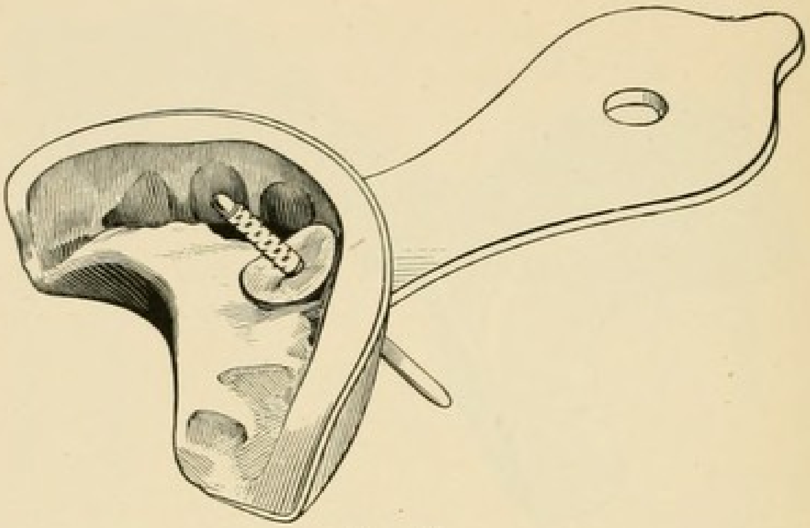


FIG. 91.

at the same time (Fig. 93), and this, too, even in the process of taking an impression for a full upper.

I may add that, although it must be rare to find, and often ruinous to make, the canals of two roots parallel, it is

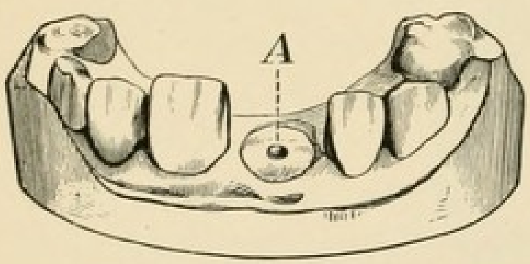


FIG. 92.

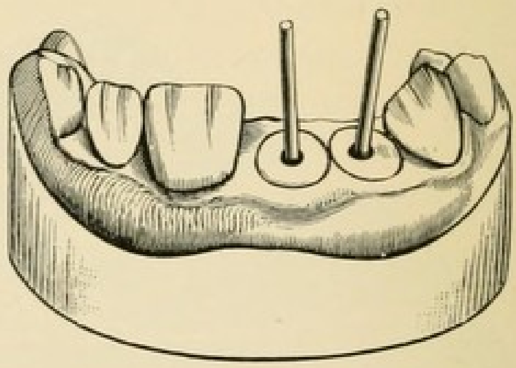


FIG. 93.

easy, with such a model as I have described, to make parallel the projecting portions of the posts inserted in the roots, and the advantages of such posts for securing plates and bridges are obvious."

The **demonstration** promised in this paper was not actually given, for the want of a patient, until the Annual Meeting of the Association in London last year (1896).

A brief description of what was then done will illustrate our general practice. The patient, in the particular case dealt with, was a female, and the tooth was a right upper central. With a saw arranged to cut at right angles to the frame (Fig. 19, p. 31), the crown was cut off level with the gum, the saw blade being kept cool the while by means of water from a syringe. The pulp, whilst still deadened by the action of the saw and the cold water, was immediately extracted by thrusting a Donaldson bristle, previously standing point downwards in carbolic acid, into the canal, twisting it round, and withdrawing it with the pulp adhering. This reads like an operation calculated to give great pain, but proves otherwise in practice, the patient in the case described not flinching at all. There was a little blood, which was carefully washed out; the canal was dried with hot air and finally by a hot platinum wire; the apex was sealed with chloro-percha on a shred of cotton-wool carried to the apex on the point of a cleanser and followed by a gutta-percha point; the root-face was trimmed to a convex form, the anterior edge being cut away to just beyond the gum margin, and the canal was drilled for the post. An impression of the root-face was then taken with the appliances above described (pp. 77—80) and a dowel-crown was fitted by the method given below.

Whatever **objection** may be imagined **against the removal of the crown of a living tooth** in the manner above described—and a little reflection should convince objectors that the tax upon the patient owing to anticipation, pain, and shock by a method so brief and unlooked for, as compared with that arising from more prolonged operations often necessarily borne without an anaesthetic, is really insignificant—**no such objection** can be raised **against the removal by sawing of the crown of a tooth in which the pulp is dead,** and a very decided advantage is to be gained by so removing it, as will be seen from what follows.

In **preparing a septic tooth for crowning,** we cut off the crown with a saw; clear out the canal with a Donaldson bristle and cotton-wool; wash with peroxide of hydrogen; dry the canal, and leave in it a pledget of non-absorbent cotton-wool, moistened with formalin and afterwards squeezed nearly dry in a napkin. We then remove the decay from the severed crown; insert a piece of wire as a post, fixing it in the crown with cement, and at the same time filling any cavity there may be; put 'temporary' gutta-percha round the post, and force the crown home upon the root while the gutta-percha is still soft.

With the crown thus restored, the patient is free from the **disfigurement due to the want of an anterior tooth,** and can afford to wait until the operator is satisfied that the root is in a fit condition for permanent treatment, a great advantage, ready access to the root being a highly important factor in the successful treatment of septic teeth.

To apply a Dowel-Crown.

Having obtained a model in the way described above (pp. 77—80), and decided, say, that it is a **case for a plate-tooth,** I take a piece of 22 carat gold (Ash's No. 4) and burnish it down upon the surface of the cast of the root to form a cap; fit a post of 18 carat gold to the canal in the model and solder cap and post together. Next, I grind a plate-tooth to fit the cap; back it with 18 carat gold for the sake of its greater hardness compared with 22 carat; solder the tooth to the back without investing (pp. 22, 23), and the back to the cap; finally strengthen the cap by flowing solder over it, and the crown is ready for the mouth.

In cases where there is **room for an all-porcelain crown,** I have hitherto used Ash's ordinary tube-teeth, but the Firm have now kindly undertaken, at my suggestion, to revive a form of tooth (Fig. 94) which they used to make some fifty years ago, and of which a specimen has been to my knowledge in the possession of myself and of my predecessors in practice for upwards of thirty years. This is a **tube-tooth with the canal directed towards its cutting edge but not penetrating to the surface,** in this resembling the recently introduced Newland Pedley crown and certain forms advertised somewhat earlier than that crown in some of the American Journals. The advantage of this form of crown over ordinary tube-teeth is that the canal, following more correctly the line of the canal in the natural tooth, does not necessitate so large a bend, if any, in the post. The post not being fixed in the crown, as in the Logan, the crown can be ground and fitted to the root. To facilitate this and

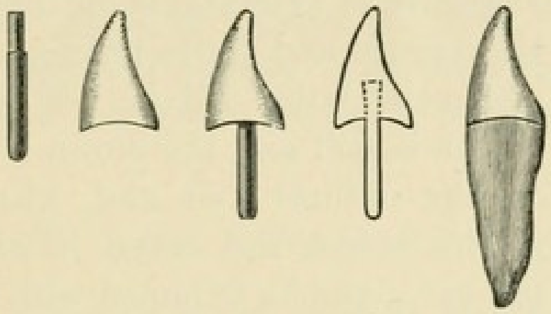


Fig. 94.

save some of the labour involved, the base of the new crown (Fig. 94) will differ somewhat from that of fifty years ago, and, to admit of a thicker and stronger post than one of pin size wire being used, the tube will be a little larger than in the present tube-teeth.

Having selected a suitable crown of this kind or an ordinary tube-tooth, I grind it to fit the root, and, to protect the plaster model while doing so, I place a strip of thin articulating paper over the root and oil the exposed surface, making a hole in the paper for the post by means of the Ainsworth Rubber-Dam Punch. Then, taking advantage of the metal-lined canal in the model, I bend the post, which may be of hard-drawn dental alloy, so as to give the tooth its proper alignment, and solder the post into the crown by the method described on page 23.

It is advisable that the part of the post which goes into the root should be somewhat thicker than that which goes into the crown, so that there may be a shoulder at the junction against which the crown may press when the post is being forced into the root.

In **fixing either of these crowns in the root** I put silk and mastic on the post and a small disc of base-plate gutta-percha between the crown and the surface of the root, proceeding as follows:—The crown being ready to leave the workshop, the disc of base-plate gutta-percha is

Fig. 95.

applied to the base of the crown, the post passing through it. Then, a light copper tube (Fig. 95) being used as a holder, the crown and gutta-percha are heated to make the latter adhere. While the gutta-percha is still soft, the crown is pressed home on the natural root and, when the gutta-percha is set, the crown is withdrawn, and the gutta-percha trimmed with a sharp knife; the root is dried; silk is applied to the post and the crown is again tried in the mouth to test the sufficiency of the silk. Thick mastic is then smeared on the silk, and the crown with the help of a crown setter (Fig. 96) is finally driven home.

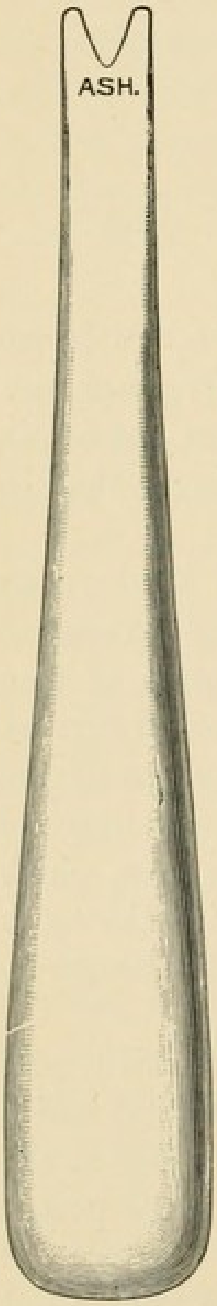


Fig. 96.

I may point out that in the event of fracture a **crown so fixed can be removed at will** without risk of disturbing the root; whereas, if cement be used, as it must be where the canal is much enlarged, this cannot be done, and consequently a fracture of the crown probably means the loss of the root. It will be seen too that, the exact position and direction of the canal being faithfully reproduced in the model, the post can be so accurately placed that **no enlarging of the root-canal** is called for beyond what is necessitated by the oval form which the canal shows in section when the crown is cut off. If a post were used which fitted the shorter diameter of this oval, spaces would be left between the post and the extremities of the longer diameter of the oval into which foreign matters would insinuate themselves and destroy the root. Moreover, the post would have room to move. It is necessary, therefore, to make the section of the canal a circle with the greatest width of the oval as diameter. But this is absolutely the only enlargement called for, unless it be necessary to remove decay.

These methods of making and fixing dowel-crowns are not, of course, put forward as **novel,** but only as seeming to me superior to those already remarked upon, and as most generally useful. The method of obtaining a model to work to is, however, new, to the best of my knowledge.

To make a Collar-Crown.

The first thing to do in making a collar-crown by the method now to be described is to obtain a **mandrel for shaping the collar** (Fig. 98). This being done in the manner already explained (pp. 45—49), the copper ferrule in which the mandrel is cast is cut through on the lingual side and peeled off, and the mandrel is trimmed into a cylindrical shape to make it easy of removal from the finished crown. The utmost care must be taken in doing this, and throughout the work, not to damage the lower margin of the mandrel, that viz. which comes into contact with the model, and which represents the neck of the tooth to be fitted.

A **suitable crown** (Fig. 97) is now struck up in the way described on pp. 49—52, chased upon the natural tooth with a steel punch carried in a handle and used as a pressure-punch (Fig. 56) and has its edge made plane by filing and rubbing on a wet slate.

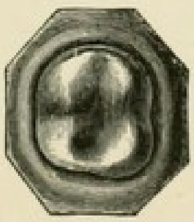


Fig. 97.

Fig. 98.

The mandrel being in position on the model with some composition, consisting of two parts of resin to one of wax, on the top of it, the crown is heated and placed upon this composition, and the **proper occlusion** is obtained by articulating the models (Fig. 98 *a*). The advantage of being able to do this in this way need hardly be insisted on.

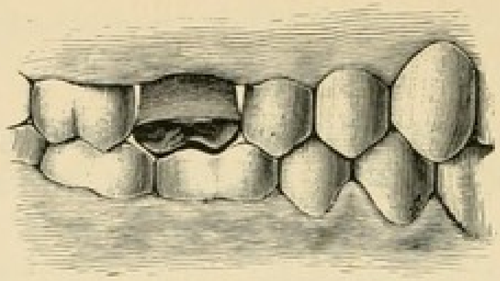


Fig. 98 *a*.

The **next step is to make up the mandrel** with the above-described composition between its lower margin and the edge of the crown as fixed by the occlusion, the composition being trimmed so as just to clear the edge of the crown and to leave the lower margin of the mandrel visible at all points (Fig. 99).

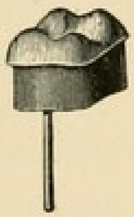


Fig. 99.

A **pattern** of the surface of the composition thus applied is now to be obtained and transferred to the gold selected for the collar. This is done as follows:—Place a strip of paper round the mandrel, making the ends meet on the lingual side and, holding the mandrel and paper in one hand, touch the points of the finger and thumb of the other upon articulating paper, and rub them all round the paper on the mandrel. On being now removed from the mandrel, the paper will be found impressed with an outline

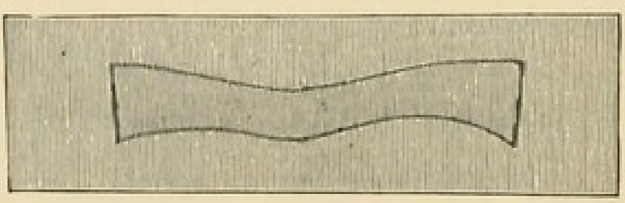


Fig. 100.

of the desired collar (Fig. 100). This being cut out, and attached to the selected sheet of gold (Fig. 101) by means of wax previously flowed over the gold, the **collar** is cut out

(Fig. 102), finally adjusted to the mandrel and soldered into a ferrule. The crown edge of this is made plane by filing and

Fig. 101.

Fig. 102.

rubbing on a wet slate, as was before done with the crown, and the other edge is filed to the form of the mandrel. The crown and the ferrule are then annealed and boiled in pickle, fitted together, held in position with a piece of bent binding-wire as shown in Fig. 103, soldered together, and the crown is complete. The crown is then boiled in pickle, and finished in the usual way. Figure 104 shows the finished work.

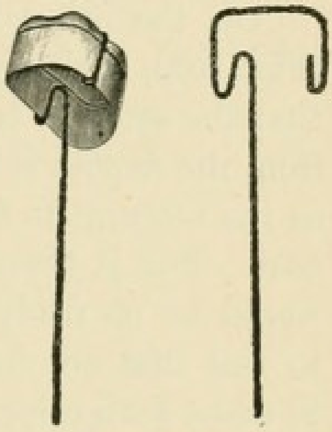


Fig. 103.

Lastly, the patient returns and, the crown having been tried on the root and found to fit, a tapering screw post may, if thought advisable, be inserted in the root (p. 32); the crown, filled

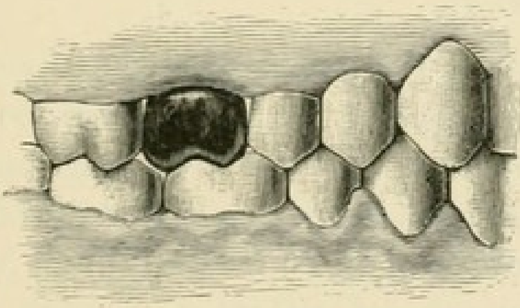


Fig. 104.

with phosphate cement, is pushed into position; the superfluous cement is removed, and the work is done.

When filling the crown with cement, it is convenient to hold it by means of a piece of tape waxed and wrapped about it; the tape will prevent the cement from smearing the outer surface of the crown.

By a method similar to that described above a **porcelain-faced crown,** or a **cap and band to carry a tube-tooth,** may be made for a bicuspid.

The precision and accuracy with which each step in the above process may be taken, and the entire absence of all uncertainty and guesswork and of the necessity for repeated reference to the natural root render this method of making a collar-crown, which may perhaps seem complicated to read about, at once simple, successful, and comforting beyond any that I have hitherto tried.

On the other hand, the shape taken by the gold strip (Fig. 102), which when soldered becomes the collar, shows that the attempt to fit a root with a ready-made collar-crown from the depôts is likely to be almost as picturesque in result as the attempt to fit Tom, Dick, or Harry with a ready-made coat. But if there were neither lame dogs nor stiles there would be no ready-made crowns, and it would be gratifying to feel that one had done something, were it never so little, to make both cripples and crutches things of the past.

The illustrations relating to the Collar-Crown above described were taken from a case in practice, the original models for which, together with the supplementary models shown above and a duplicate crown, are now at the Dental Hospital of London.

In **conclusion,** I can only hope that those of my readers who may have persevered in following me so far will forgive the possibly obtrusive egotism attending much that I have said, as being perhaps inevitable under the circumstances.

If they should also agree that anything here put forward is at any rate worthy of refutation, I shall feel that something has been gained in the promotion of a discussion which will ultimately lead to the adoption of the best methods, and to the lasting benefit of those whom it is at once our duty and our pleasure to serve.

APPENDIX.

APPENDIX.

WORKING DESCRIPTIONS OF METHODS TREATED OF IN THE FOREGOING PAGES.

For reference in Workroom or Surgery.

Making a Collar-Crown.

1. To make a mandrel for the collar.

Prepare the root by sawing off the crown, if any, to within about a sixteenth of an inch of the gum by means of a saw

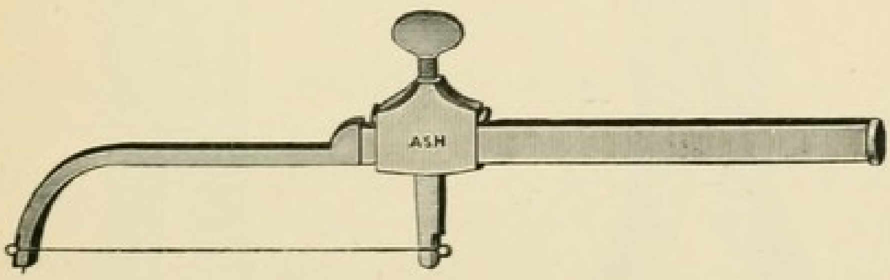


Fig. 1.

cutting at right angles to its frame (Fig. 1). Strip off the enamel with trimmers (Ash's, Nos. 3 and 4), to make the root cylindrical, and build up with amalgam should the decay extend beyond the

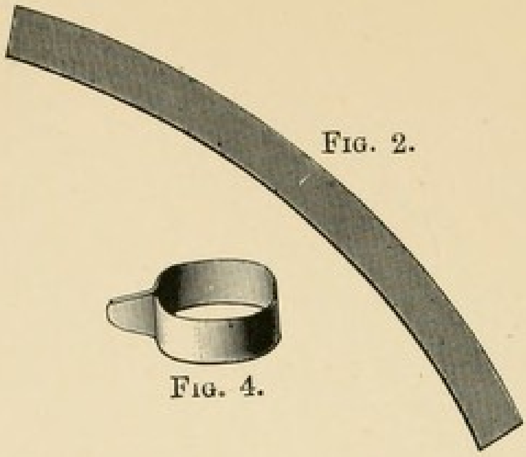


Fig. 2.

Fig. 4.

Fig. 3.

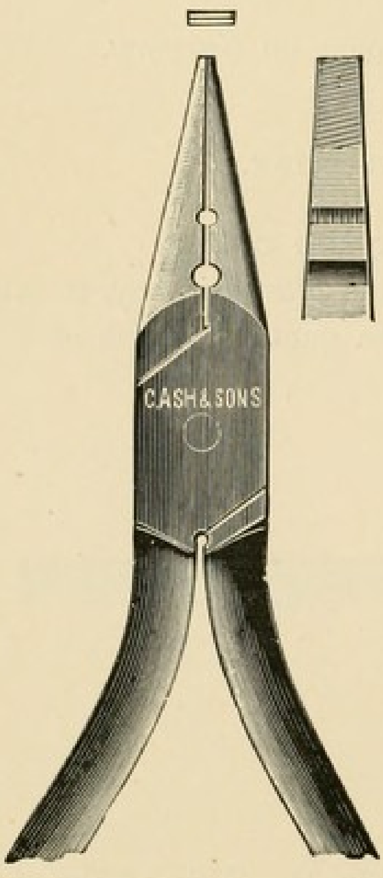


Fig. 3*a*.

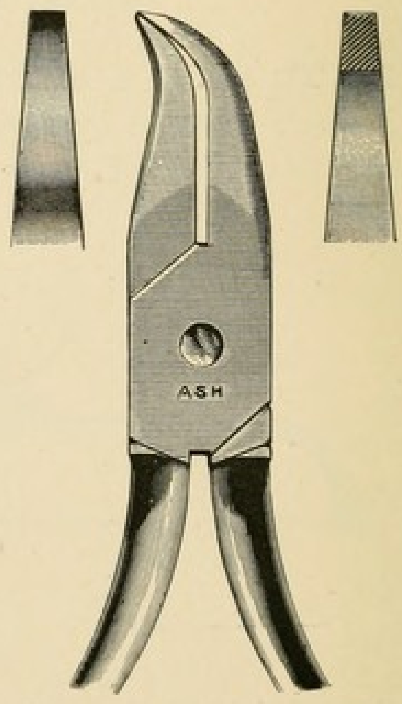


Fig. 3*b*.

gum margin. Place a copper strip (Fig. 2) about a natural tooth, somewhat smaller than the root to be treated, and draw it into shape by grasping the ends with pliers (Figs. 3*a* or 3*b*). Anneal and boil the resulting ferrule (Fig. 4) to make it soft and clean; place it about the root, and draw the ends together with the pliers, as before, until its shorter edge takes accurately the form of the root as far beyond the gum margin as the strip will go. Remove the ferrule, *still* grasped by the pliers; wash and dry, and solder with soft solder. Trim the ends as in Fig. 4; replace the ferrule

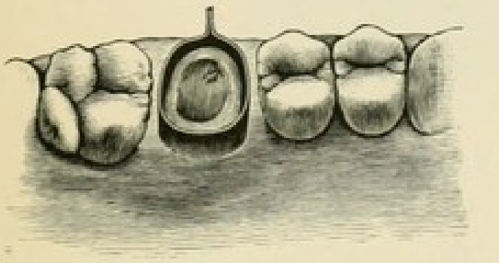


FIG. 5.

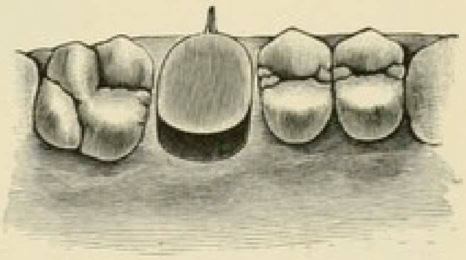


FIG. 6.

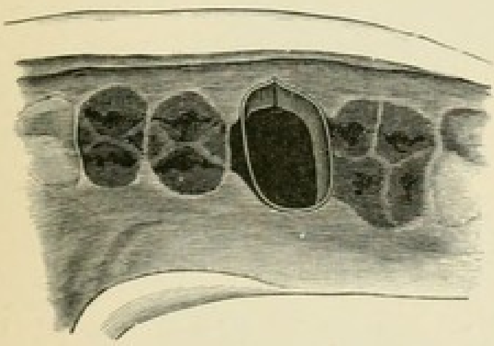


FIG. 7.

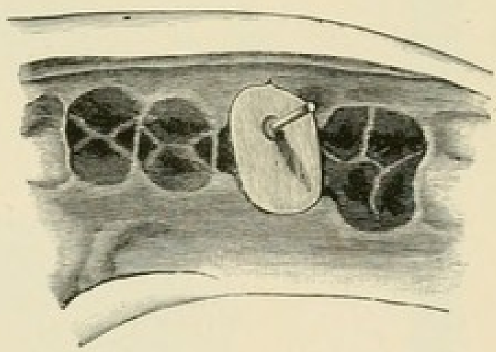


FIG. 8.

as far on the root as before (Fig. 5); lightly fill with wax (Fig. 6), leaving the edge of the ferrule clear; and take impressions of both jaws with composition. Having removed the impressions, replace the ferrule if disturbed; fill with wax the part not yet filled, which should then be visible (Fig. 7); and scrape down the wax until the edge of the ferrule can just be seen all round (Fig. 8). Warm the head of half an ordinary brass pin, and thrust it head downwards into the wax towards the buccal side of the ferrule (Fig. 8), taking care to keep the pin upright. Make the plaster models with the ferrule and pin in position in the impression. Draw the model, taking care not to disturb the ferrule from it (Fig. 9), and scald out the wax. Remove the pin; cut a small depression (Fig. 10) in the plaster within the ferrule towards its lingual side by means of the excavator (Fig. 11); replace the pin; pour fusible metal into the ferrule from the cup (Fig. 12) standing ready in boiling water; and press lightly with the finger upon the metal

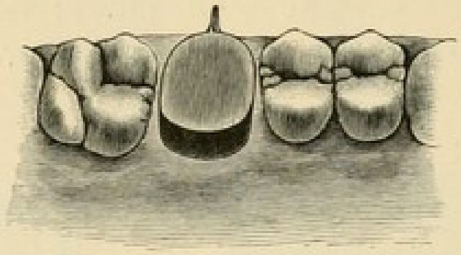


FIG. 9.

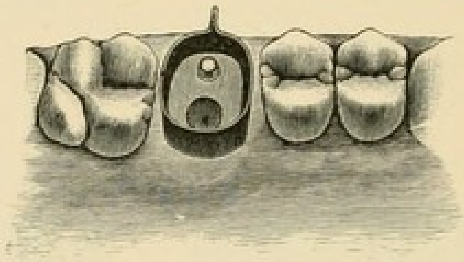


FIG. 10.

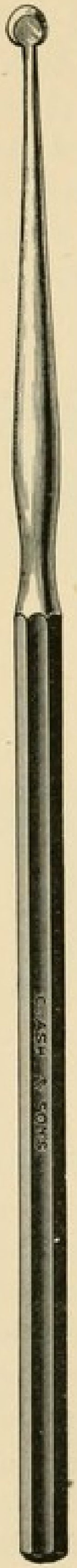


FIG. 11.

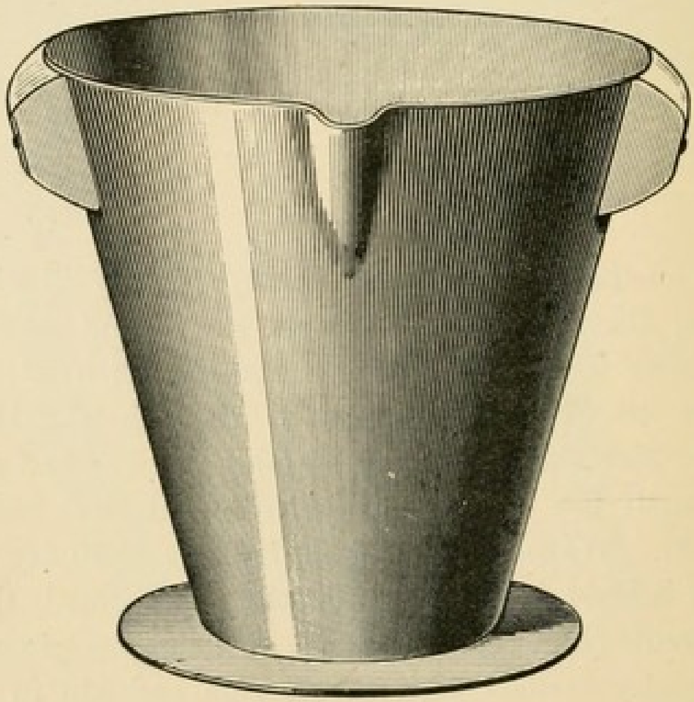


FIG. 12.

as it cools (Fig. 13). Remove the mandrel and ferrule from the model, cut the ferrule through on the lingual side, and peel it off the mandrel. A mandrel is thus obtained in fusible metal, with

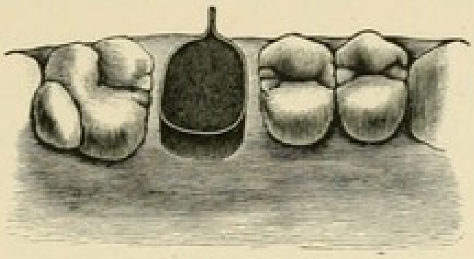


FIG. 13.

a pin and a boss (*A*, Fig. 3, or Fig. 14) to fix its position on the model. Trim the mandrel to make it cylindrical and easy of removal from the finished crown, but be careful not to touch its lower edge, unless the ferrule was found to leave the root too easily, in which case the lower edge may be slightly reduced by scraping.

FIG. 14.

Figure 15 shows a mandrel in position on the plaster model, ready for use in shaping the gold collar to which the crown (grinding surface) is to be soldered.

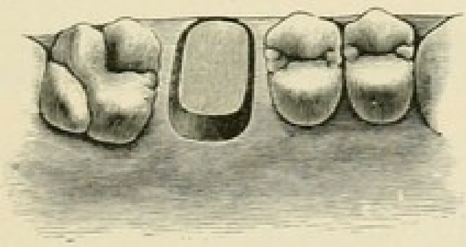


FIG. 15.

2. To make a die for striking up a gold crown.

Fill the split ring in the mould (A, Fig. 16) with composition, and allow it to cool. Warm the exposed end of the composition to the depth of about an eighth of an inch; wet and plant a natural tooth, crown downwards, in the centre of it (Fig. 16). When the composition is again cool, remove the tooth, and polish the surface of the composition with a file and glass paper, finishing with the back of the paper. Slightly warm the tooth, and replace it in the composition. Warm the split ring (Fig. 17), and place it, large end downwards, on the composition, so as to be co-axial with the tooth. From the cup (Fig. 12) pour into this ring enough fusible metal to cover the root, which may be shortened if necessary. Slip up the wires on the split ring a little and remove the die (Fig. 18). Make a mark on the lingual side of the die with the excavator (Fig. 11).

A die of this kind may be made somewhat more readily by

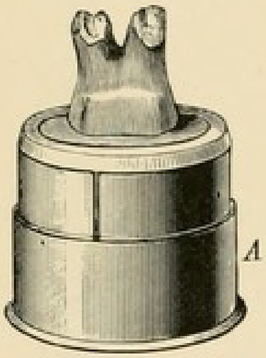


FIG. 16.

FIG. 17.

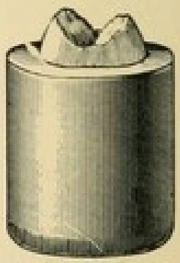


FIG. 18.

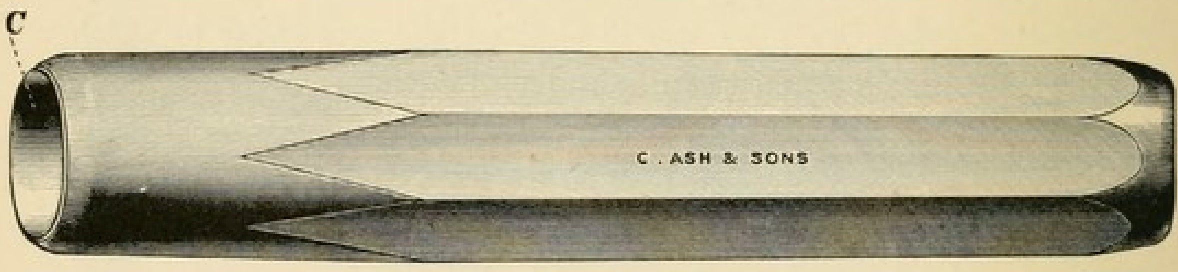


FIG. 19.

the use of clay instead of composition, the surface of the clay being made smooth by passing a piece of glass over the end of the split ring containing the clay. No warming and polishing are then necessary, but the resulting die is less finished than that obtained by the use of composition.

3. To strike up a crown.

Insert a die (Fig. 18) into the punch (Fig. 19). Wet a piece of sheet gold (No. 6) ; place it on bees-wax, melted into and filling the bottom of a vulcanite flask, and drive the gold into the wax by a few blows of a hammer upon the punch, keeping the mark on the die always in one direction, say towards the person ;

anneal the gold about three times in the process. Fig. 20 shows the result.

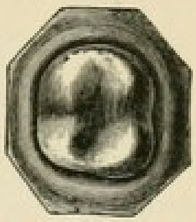


Fig. 20.

If the weather be warm, cool the wax before using it by letting water run on to it from a tap.

Drop the die, face uppermost, into the hole in the board (Fig. 21) to keep it steady, and chase the crown (Fig. 20) upon the natural tooth with a steel punch (Fig. 22), carried in a handle and used

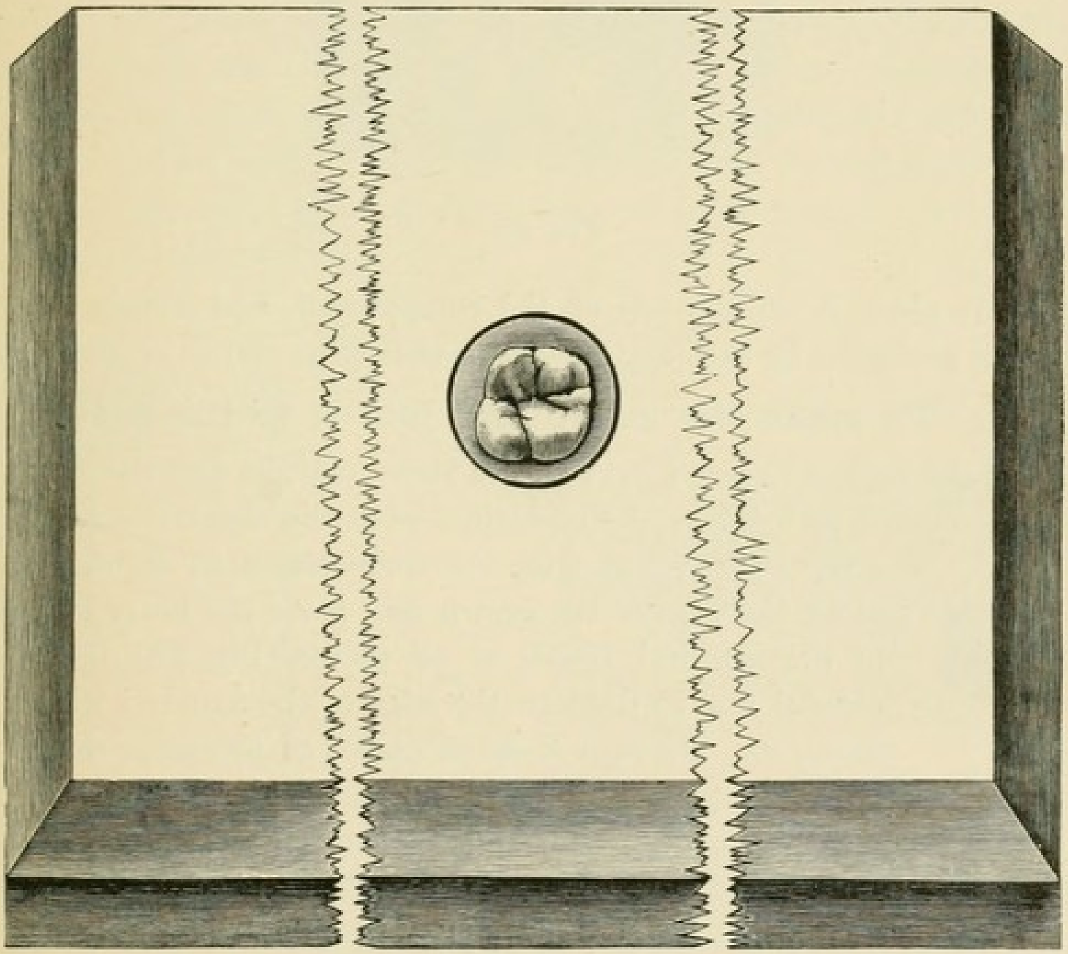


Fig. 21.

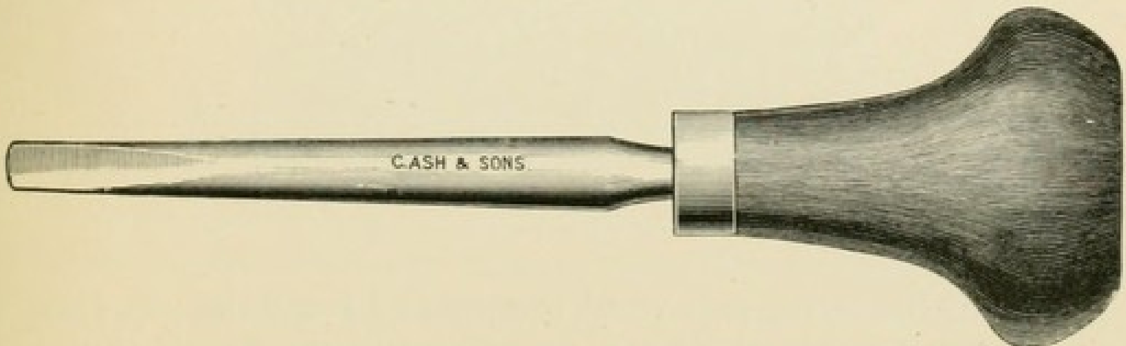


Fig. 22.

as a pressure-punch; trim the crown with shears, and make the edge plane by filing and rubbing on a wet slate.

4. To obtain the occlusion.

Make up the mandrel with composition, consisting of two parts of resin to one of wax, to a height calculated to give a suitable occlusion, and place it in position on the model. Heat the

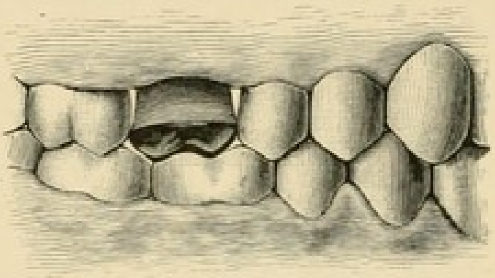


Fig. 23.

crown; place it on the top of the composition, and obtain the proper occlusion by articulating the models (Fig. 23).

5. To make the collar and join it to the crown.

Make up the mandrel between its lower margin and the edge of the crown, as fixed by the occlusion, with the above described composition; and trim the composition so as just to clear the edge of the crown and leave the lower edge of the mandrel visible at all points (Fig. 24), being careful not to damage the edge of the mandrel while doing so. Place a strip of paper, of the same shape as the copper strip (Fig. 2) but wider, round the mandrel, making the ends of the paper meet on the lingual side. Holding the mandrel and paper in one hand, touch the points of the forefinger and thumb of the other

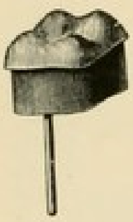


Fig. 24.

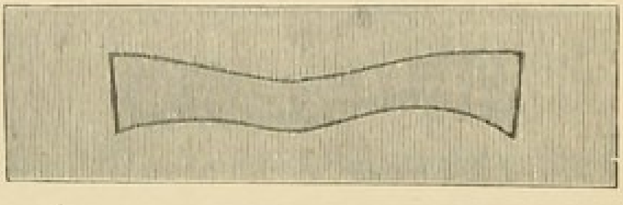


Fig. 25.

hand on articulating paper, and rub them all round the paper on the mandrel. Cut off what is superfluous in the length of the paper, remove the paper from the mandrel, and cut out the pattern outlined upon it by the rubbing (Fig. 25). Flow some wax over one side of a piece of sheet gold (No. 6 or thinner),

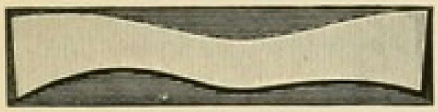


Fig. 26.

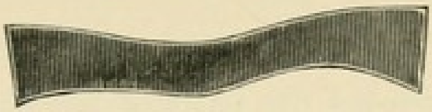


Fig. 27.

attach the paper pattern to the waxed surface by heating (Fig. 26), and cut out the gold to the pattern (Fig. 27). Wrap the strip of gold about the mandrel, bringing the seam to the lingual side; make any little adjustment that may be required, and solder the strip into a collar. Make the crown edge of the collar plane by filing and rubbing on a wet slate, and file the other edge to the form of the mandrel.

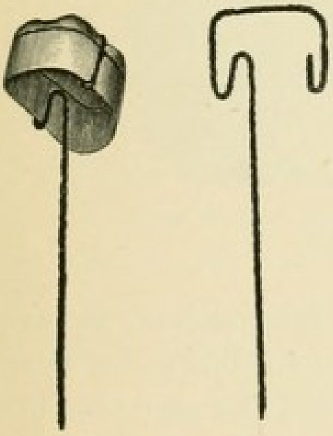


Fig. 28.

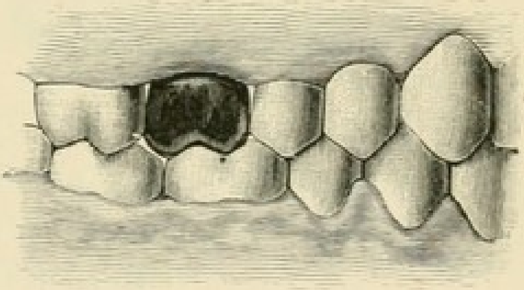


Fig. 29.

Anneal and boil the crown and collar; fasten them together with a piece of binding wire, bent as in Fig. 28; solder; and the crown is complete (Fig. 29).

Repairing Vulcanite Plates.

6. To repair a vulcanite plate from which a single tooth has been broken.

Cut a dovetail as if about to vulcanise a tooth in. Drill two small depressions, one in either edge of the dovetail; secure the tooth in position temporarily from the front with shellac; melt some fusible metal into the dovetail with the handle of an excavator (Fig. 11) made hot, or by pouring from the cup (Fig. 12), and apply a slight pressure with the finger to the metal as it cools.

It is best to use flat-teeth for incisors or canines.

7. To repair a cracked vulcanite plate.

Secure the parts of the plate in position with wax, and set it in plaster of Paris. To the part where the strengthening plate is to be attached, apply a disc of sheet wax rather larger than the metal plate is to be; cover this completely with composition, and make a hole in the centre of the composition through which

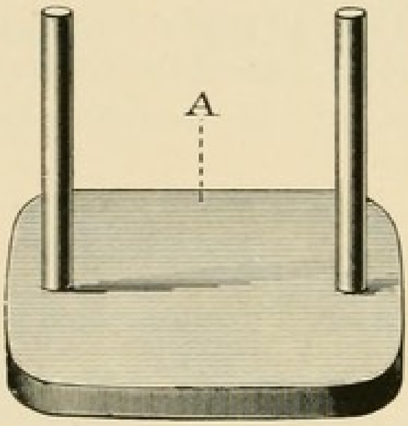


FIG. 30.

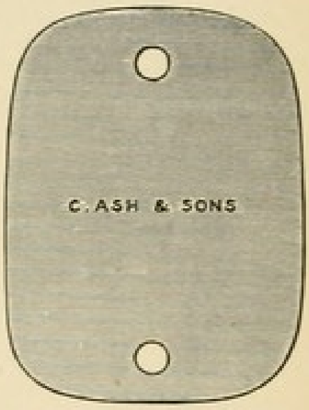


FIG. 32.

fusible metal may be poured. Lift off the composition, remove the wax, replace the composition, and pour in fusible metal from the cup (Fig. 12). Set the cast thus obtained, face downwards, in a layer of clay on the plate *A*, Fig. 30. Wind a strip of celluloid about the posts (Fig. 30), secure it with string so as to form a ferrule round the posts, and pour fusible metal from the cup (Fig. 12) into it to unite with and strengthen the cast (see Fig. 31, *A* and *B*). Place the die thus strengthened, face upwards, between the posts (Fig. 30); smear the face with rouge and water, or whiting and water, and with the help of the celluloid ferrule cast the counter-die (Fig. 31). To strike-up the metal plate,

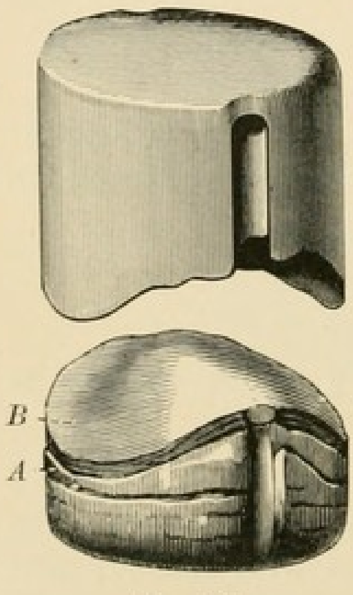


FIG. 31.

place the washer (Fig. 32) upon the plate *A*, Fig. 30, then the die face upwards, then the plate to be struck-up, then the counter-die, in the order named, and hammer away.

The purpose of the washer (Fig. 32) is to raise the counter-die above the tops of the posts to permit of the striking-up process.

Making New Vulcanite Plates.

8. To make a base or trying-in plate.

Fit a wax-plate to the usual plaster model, and trim it to the size of the desired trying-in plate. Make a rod of wax about three times as thick as the wax-plate and half an inch wide, and place it along the centre-line of the model from the back of the wax-plate to the back of the model. Wet the wax and cover the whole completely with composition, from a quarter to half an inch thick. When this is set, remove it and take out the wax; replace the composition on the model, and see that the orifice made by the wax rod extends not less than an inch further back than any part of the wax-plate extended. Then, holding the mouth of the orifice uppermost, pour in fusible metal from the cup (Fig. 12) till the orifice is completely filled. When the cast is set, remove the composition; carefully work off the plate from the model, and trim it up with the handle of an excavator (Fig. 11) made hot. Sometimes, in flasking, a plate thus obtained will be found difficult of removal from the model when invested. In such a case, divide the plate into two or more parts by means of the excavator handle made hot, and remove the parts separately. If the plate happens to have been at all rough, smooth the model cast by means of it (p. 12) by rubbing with the finger wrapped in a soft rag.

9. To make an articulator.

Trim the models so that, when articulated, their backs will sit comfortably in the square tray (Fig. 33). Fix the small oval tray (Fig. 34) by means of the split tube and disc (Fig. 35) in the centre of the tray (Fig. 33); trim the models, and adjust the tray (Fig. 34) so that it will pass between the models when the latter are held in the position given by the bite and seated comfortably on their backs in the larger tray. If using the trays for the first time, paint all the interior with rouge and water. Place the square tray (Fig. 33) in a shallow pan of water; put in as much fusible metal as will, when melted, from a half to three parts fill the tray, and make the water boil. When the metal is melted, remove the tray from the pan; pour away the hot water; replace the tray in the empty pan; invest the models in correct occlusion in the molten metal, and pour cold water into the pan to hasten the cooling. Remove the models and the split tube and disc

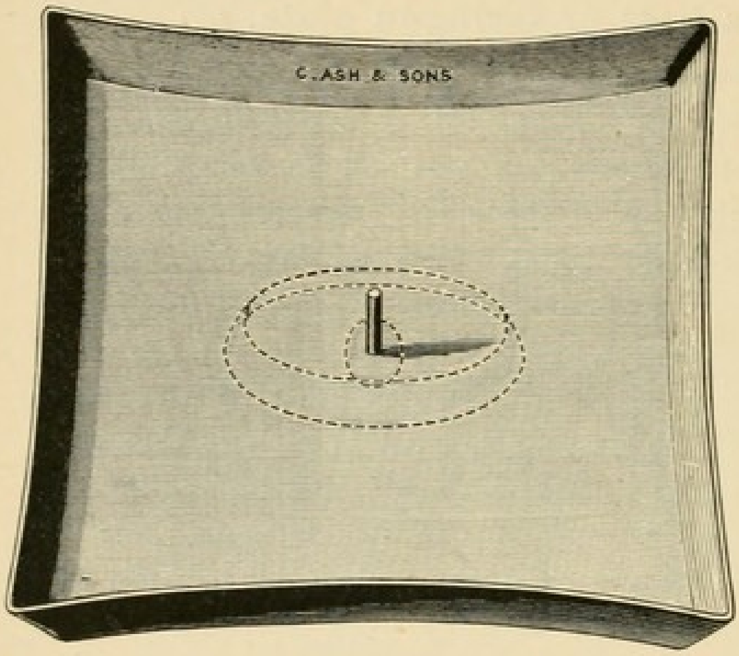


FIG. 33.

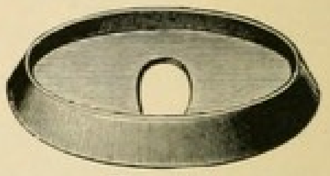


FIG. 34.

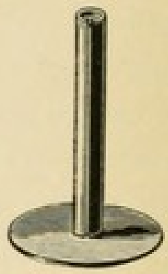


FIG. 35.

(Fig. 35); turn out the slab from the tray (Fig. 33), and push out the small oval tray (Fig. 34) from the centre of the slab.

Of course, the backs of the models must be so trimmed, or made up with clay, before being invested, as to be capable of removal from the metal slab (see Figs. 36 and 37).

MATRICES.

10. To apply, retain, and remove matrices.

Take a matrix (Fig. 38) of the size required, and with a suitable pair of pliers bend each end to a right angle along one of the lines marked upon it. Slip the 'lugs' so formed into the slots of the clamp (Fig. 39), which should be previously opened wide for the purpose, taking care to insert the lugs in such a way that,

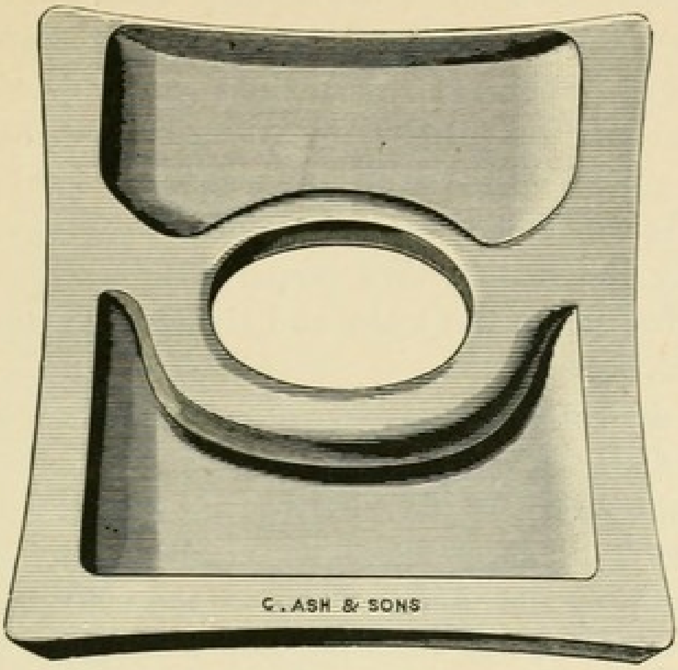


Fig. 36.

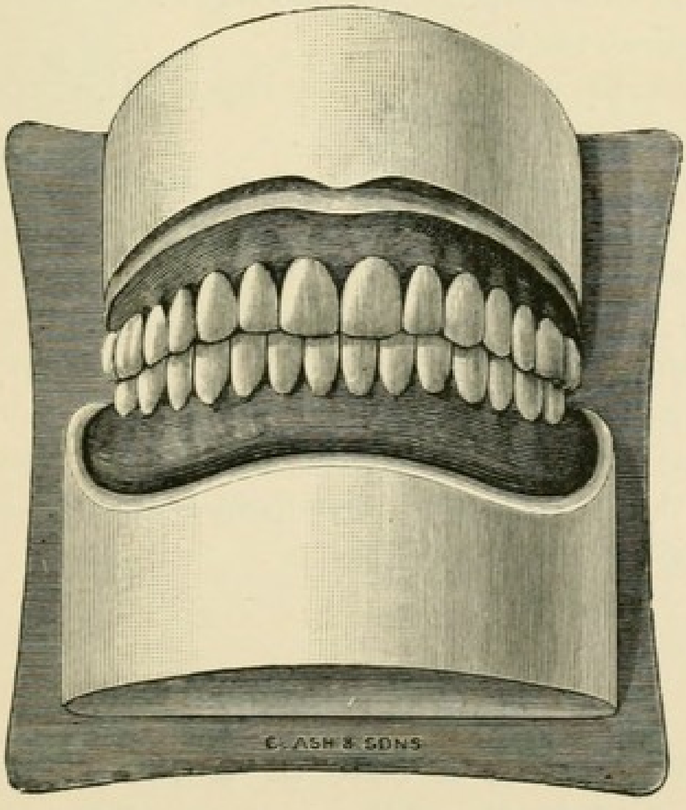


Fig. 37.

when the matrix is on the tooth the head of the clamp-screw shall be towards the front of the mouth. Pass the matrix on to the ungrooved end of the shaping-tool (Fig. 40), and tap it into symmetrical shape (Fig. 41); then slip it on to the other end and press grooves into the lower margin at such points as will accommodate the grooves in the tooth to be treated. The upper margin of the matrix may sometimes be contoured with advantage.

To *apply* the matrix thus prepared to the tooth, slip the *small end first* on to the tooth and tighten the clamp with the key (Fig. 42).

If it is desired to *retain* the matrix upon the tooth for a few hours after filling, attach a loop of wire to the twister (Fig. 43) by threading the ends of the wire through the holes in the instrument and twisting them round the handle. Slip this wire loop over the clamp and behind the lugs of the matrix, and, holding the instrument so as to close the loop lengthwise of the tooth, first give it a few turns so as to twist the ends of the wire together; then remove the clamp, and give the twister a few more turns to tighten the wire. Cut off the superfluous wire, bend the cut ends behind one of the lugs of the matrix, and press the lugs against the tooth.

To *remove* the matrix, draw the lugs together, and slip off the loop.

To *shorten* a matrix, bend it at an inner line, after clipping the end to the same shape as for an outer line.

To *reach a very deep cervical cavity*, clip away either or both lugs along the lower margin, that is, along the shorter curve of the matrix. The strip cut off should narrow away to nothing before the middle of the matrix is reached, and the effect will be to somewhat straighten the shorter curve of the matrix, but this will have the desired effect, and more cannot be done without disadvantage.

Dowel-Crowns.

11. To obtain a cast of a root-face with the direction and depth of the root-canal for the purpose of making a dowel-crown.

Trim the root-face to a convex form; seal the apex; prepare

Fig. 39.

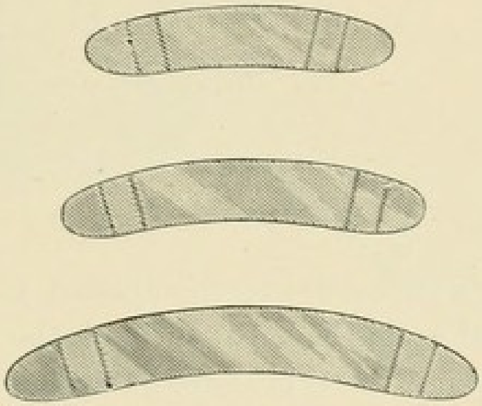


Fig. 38.

Fig. 41.

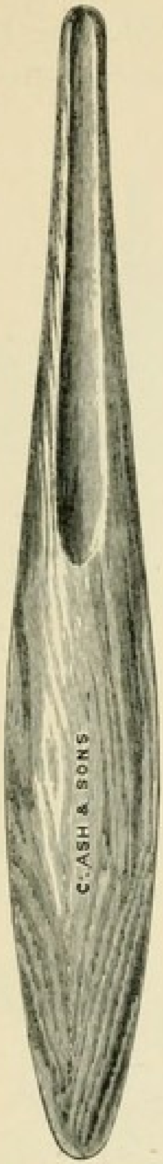


Fig. 40.

Fig. 42.

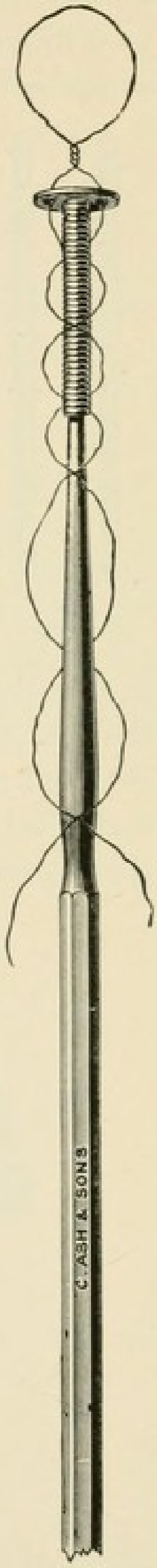


Fig. 43.

the canal, and take the depth of the canal with one of the root-sounds or measuring-posts (Fig. 44).

Fill with composition a conical cap of suitable size (Fig. 45), which can be made narrower by pressure, if necessary, so as to

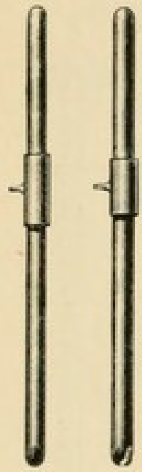


Fig. 44.

Fig. 45.

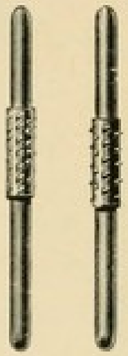


Fig. 46.

Fig. 47.

pass readily between the teeth adjacent to the root; pass one of the root-canal posts (Fig. 46) through the middle of the composition and through the orifice at the apex of the cap, a broach being first used to open up a way for the post; soften the surface of the composition and shape it into a mound about the post

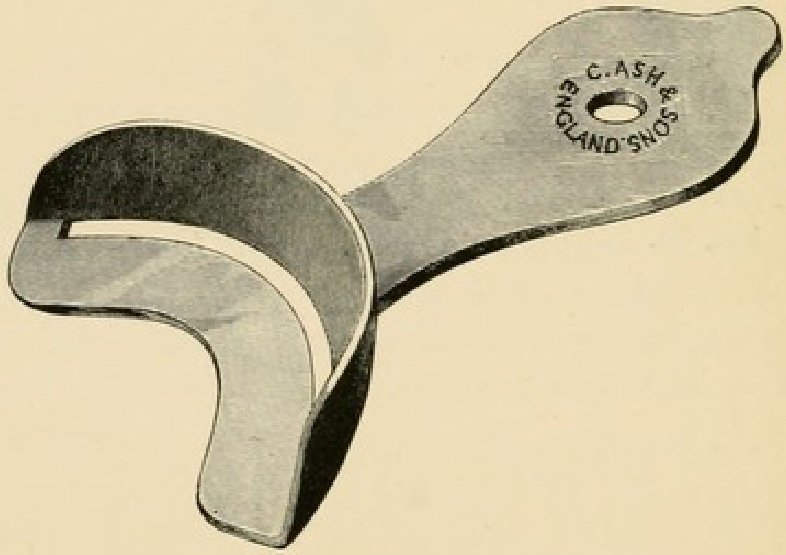


Fig. 48.

(Fig. 47). Apply the cap thus filled to the root-face, while the composition is still soft, first passing the post into the canal, then pressing the cap home and cooling it by means of a syringeful of cold water.

Remove the cap and post from the root; cut away the superfluous composition from the outside of the cap; reapply the post and cap to the root, and take the general impression with one of the trays shown in Figs. 48 and 49. In doing this make

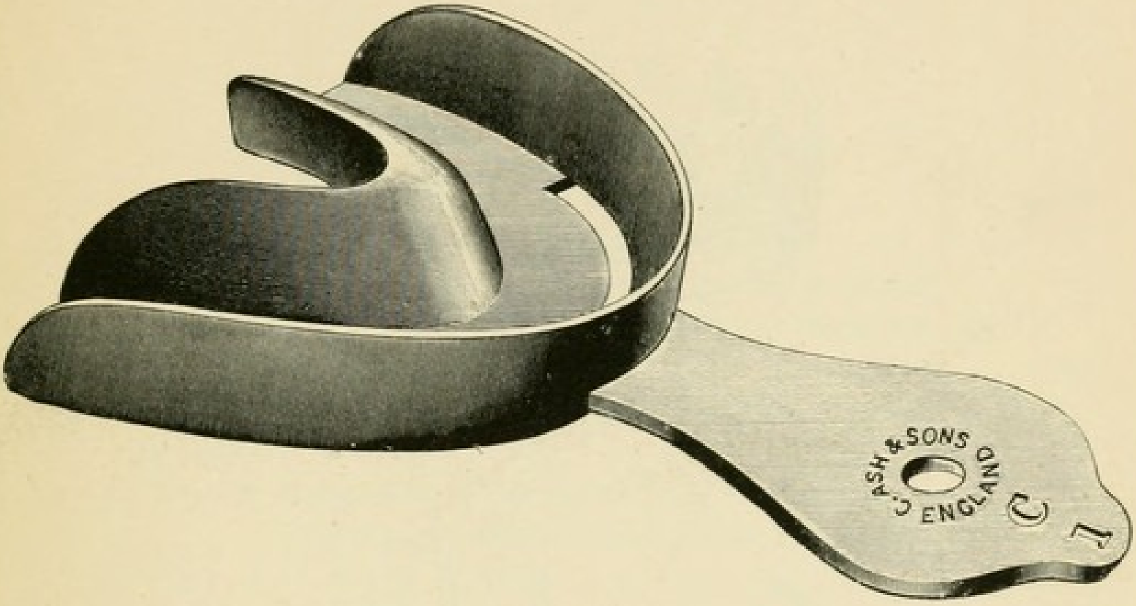


Fig. 49.

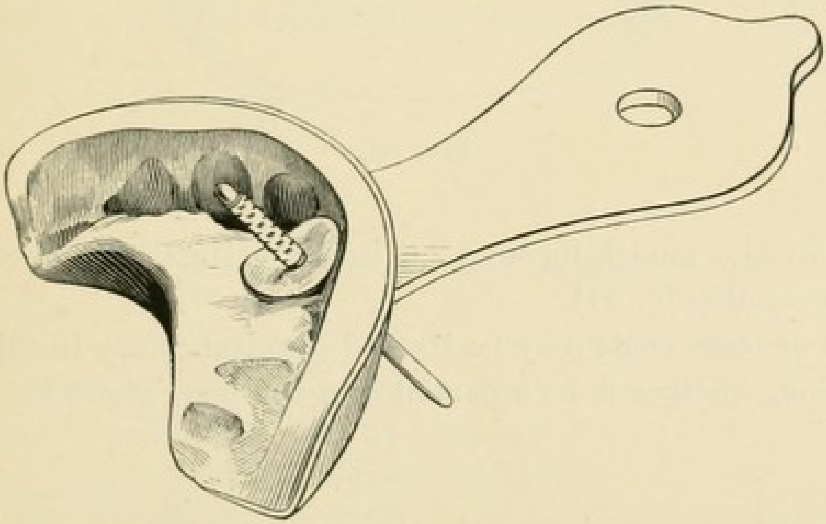


Fig. 50.

the post strike the centre of the composition in a direction towards the front of the tray which will then guide the post unerringly through the slot. Cool the impression by means of the syringe as before; remove the post, and then the impression.

Replace the post in the impression, and fix it with wax applied to the tray; place a short roughened copper tube on the end of the post which is to enter the plaster model (Fig. 50); cast the model; withdraw the post, and the copper tube will remain

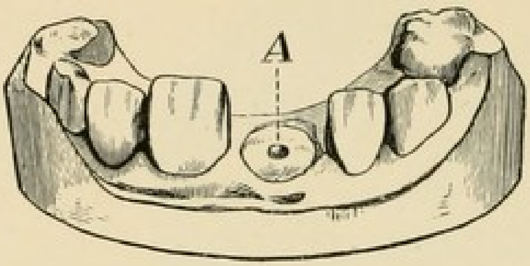


Fig. 51.

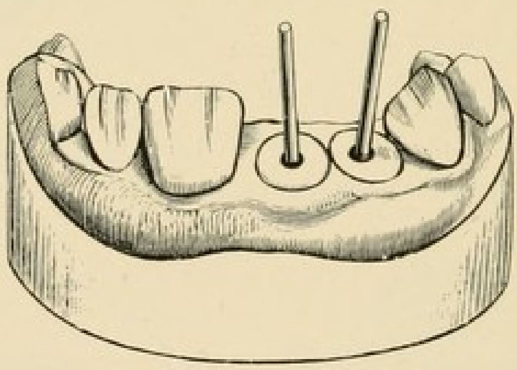


Fig. 52.

behind in the model, forming an indestructible reproduction of the root-canal (Fig. 51).

Two or more roots may be treated simultaneously in the same impression, whether it be a partial or a full one (Fig. 52).

INDEX.

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