

THE TREATMENT OF PULPLESS TEETH;
THE TECHNIC OF CLEANING AND FILLING CANALS*

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IN THIS PAPER I desire to direct your attention to the treatment of pulpless teeth and give you the details of a method of cleaning and filling the canals which has proven successful in my practice. That you may judge for yourselves as to the result of the work, I will show by means of lantern slides radiographic findings before and after treatment. In the group of cases selected you will find almost every possible pathologic condition associated with pulpless teeth. In view of our present knowledge of focal infection and its relation to systemic disease, I consider the subject under consideration here one of the most important before our profession today.

While it is true, generally speaking, that pulps which are diseased beyond the condition of active hyperemia should be removed, it also is true that this organ has been destroyed far too ruthlessly in the past. The work of Roseneau, the observations of Hunter, Murphy, Billings, the Mayos, Crile, and others of the medical profession, and the investigations of Hartzell, Grieves, Rhein, Price, Gilmer, Logan, Moorehead, Black and others of our own profession, along the line of periapical infections and the systemic results, should teach us to conserve the healthy dental pulp in every case where it is practicable and consistent with good dentistry. Thousands upon thousands of normal pulps have been sacrificed for no other reason than that the dentin of the tooth was hypersensitive. When we think of the difficulty—not to mention the carelessness—under which these pulps often are removed, and of the frequent periapical infection resulting therefrom, we behold a sad spectacle, indeed. Such results should teach us that this practice must cease.

It is not my intention in this paper to discuss the methods in vogue of destroying the vitality of the dental pulp. It makes no difference to me how the pulp is destroyed so long as the results are satisfactory. In my own practice I use both pressure anesthesia and devitalization. In cases of pressure anesthesia, which is the method generally employed, where I know in advance that this operation is to be performed, I usually make one application of desensitizing paste which permits my reaching the organ without pain in those cases where there is a cavity, and of making a depression or cavity painlessly in those cases where no cavity exists. In this manner the desired end is accomplished with

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very little pressure and the less the pressure the better the results will be. I also desire to state that quite frequently I still use arsenic trioxid.

Action of Arsenic Trioxid: At the present time there is considerable discussion in dental literature as to whether or not the effects of arsenic trioxid when applied to a dental pulp are self-limiting. Some men of high standing in the profession are of the opinion that the drug is too destructive an agent to be used for the purpose of pulp devitalization. It seems to the author that these opinions are not well founded when we consider the long clinical record of the drug as a devitalizing agent. It has been used since 1836. There can be no question regarding the harmful effects of the drug when injudiciously employed. Its action is not self-limiting. Its effects are produced only after the drug is absorbed by the tissue elements, altering or destroying their vital processes in an obscure manner. The reason why the drug may safely be employed in devitalizing the pulp of a fully-erupted tooth lies in the fact that here the effects are confined to the pulp tissue, since the organ dies by strangulation at the apex, due to the congestion caused by the drug when so used. Thrombosis and death of the pulp take place and, owing to the small foramina of the tooth-root, absorption of the drug by continuity of tissue is prevented. In those cases where the apices of the roots are not fully formed, the drug, if used at all, should be left sealed in the tooth for a short time only.

Diagnosis of Dead Pulp: It is not a difficult matter, as a rule, to differentiate between teeth containing living and dead pulps. The clinical history, the color of the tooth, its response or nonresponse to thermal or electrical stimuli, will lead us to suspect that the pulp is dead or alive. Now we are ready to confirm our diagnosis. One of the best means of confirming the diagnosis of a dead pulp is the use of electricity by an instrument known as the "vibrating coil." This consists of a dry cell and a vibrating coil with a switch to control the current. The cord leading from the positive pole is arranged with a holder so that a broach may be attached; cotton is wrapped around the broach and moistened when it is applied to the suspected tooth. The cord from the negative pole is attached to a metal holder, which is held by the hand of the patient; thus the circuit is completed. A stronger current may be had by moving the positive pole to the right on the instrument board, or by gradually withdrawing the cylinder which runs through the coil. One always should start with a weak current, gradually increasing the strength if no response is obtained. It is best to apply the current first to a tooth known to be vital, and use this as a control or guide. When two approximating teeth contain metal fillings, the current should be applied to the tooth so as not to come into contact with the filling of the adjoining tooth, which, if vital,

would respond, leading one to believe that the tooth to which the current is applied is vital, when as a matter of fact, it may be pulpless.

After the diagnosis of a dead pulp has been confirmed, the pulp chamber should be opened freely with a suitable round or special pulp chamber bur. It is not enough here simply to determine whether the pulp is dead or alive; but, if dead, an effort should be made to determine the exact pathologic condition. These cases too frequently are treated by opening the pulp chamber and placing therein a pledget of cotton dipped in the most convenient remedy at hand, leaving the cavity unsealed for fear of causing septic pericementitis or an acute alveolar abscess, and making no effort to ascertain whether the invading germ is of the saprophytic variety, as usually is the case, causing pulp decomposition, with gaseous end-products, or whether the infection is caused by pyogenic micro-organisms, producing pus on the exposed surface, or, as sometimes occurs, within the substance of the tissue. It is highly essential, therefore, when a patient presents with an aching tooth that we take the time and trouble to determine not only whether we have a live or dead pulp with which to contend, but if the pulp is dead, whether the condition is a so-called septic pulp with pus formation (pulpal abscess) or one of true gangrene (putrescence). To confirm our diagnosis the tooth should be isolated and kept dry, preferably with the rubber dam, and a careful examination made. On no other basis can rational therapeutics be practiced.

Treatment of Pulpless Teeth: When a patient presents with a pulpless tooth, the original pulp tissue generally is in either a moist gangrenous condition, as a result of the action of saprophytic bacteria, or a previous attempt has been made to remove the pulp and fill the canals. In either case the first treatment here, in my opinion, should be a dressing of formocresol. Other preparations may be just as effective, but this is the one I have used for years and about which I can speak with assurance. Under aseptic precautions this remedy should be placed in the pulp chamber only, and the dressing retained with cement. This dressing should remain at least twenty-four hours, and in the interim a radiograph of the tooth and periapical area should be obtained. I know that many good men today advocate the immediate cleansing of a gangrenous canal, but I am firmly of the belief that the safest and best practice is to first apply at least one dressing of formocresol.

Some of our scientific investigators, notably Black and Price, have cautioned against the use of strongly-disinfectant drugs in the canals of teeth and have advocated the use of mildly-antiseptic remedies, whatever the condition may be. These precautions are timely where the use of such drugs is contraindicated; but if there is any place where strong disinfectant remedies may be used wisely and safely, it is in the canals

of teeth containing the gangrenous remains of a dead and putrifying pulp. In clean and noninfected canals mildly-antiseptic drugs are indicated, or better yet, no drugs at all. We never should needlessly destroy tissue, but the temporary effect of strong disinfectant drugs on the periapical tissue is the least important consideration here. We must sterilize these infected canals and fill them in such a manner that sepsis will not recur, even at the possible expense of destroying some tissue in the periapical area. This accomplished, nature soon will repair the damage done; but if we fail in this respect, all our efforts are lost. It has taken the courage of Rhein, who has dared in the face of much unfair criticism, amounting in some instances to ridicule, with metallic sodium and potassium even to "burn" his way to and through the root-ends of pulpless teeth; it has taken the steady, quiet but persistent efforts of Callahan with his sulphuric acid to correct the erroneous impression that has been made upon the profession respecting the danger of strong disinfectants in the canals of pulpless teeth, without any qualification as to where such drugs could or could not be employed safely. All credit is due Rhein and Callahan for the better root-canal work that is being done today. These names stand out in bold relief and they continue to get brighter and brighter as the years go by and as the importance of thorough root-canal work is more appreciated by the profession. We need not agree in every detail with the methods and technic of these men; but we should unite as one man to honor them for the trail they have blazed and the great good they have accomplished.

I trust that I may be pardoned for my slight diversion here, and will now return to my subject. Hartzell, Gilmer, Moody and others have found that the predominating organism in the conditions resulting from a gangrenous pulp, therefore the group active in bringing about the decomposition, is a streptococcus. One initial treatment of formocresol in these cases, while it may not kill all the organisms present, certainly will lessen the number and lower the virulency of those remaining. Surely no one will deny the favorable and valuable effects of formaldehyd gas on the intermediate and end-products of pulp decomposition. With these poisonous and irritating products chemically neutralized, with the bacteria inaugurating the process killed or their virulency lowered, we may the more safely, I believe, work to the root-end, clean and enlarge the canal by a chemico-mechanical process. By this I mean the use of chemicals in connection with broaches, reamers, files and other necessary instruments. So far as I know, there are three chemical agents in general use for this purpose—metallic sodium and potassium, as advocated by Rhein; sulphuric acid (thirty per cent.) by Callahan; and phenolsulphonic acid (eighty per cent.) by myself.

In a paper which I read before the National meeting at Louisville, and which appeared in the March (1917) number of the *Journal of the*

National Dental Association, I discussed the chemistry of these agents, stating my reasons for not employing sodium and potassium, except in rare instances, and giving the advantages which, in my opinion, the acid method possesses over the alkali for the purpose under consideration. I also mentioned in this paper the advantages which phenol-sulphonic acid has over plain sulphuric acid, and as I use the former almost entirely in my practice, I shall mention these advantages here.

Advantages of Phenolsulphonic Acid: The consistency of this agent is thick and syrupy, rather oleagineous in character, in the eighty per cent. strength which is recommended; thus a drop will adhere to the end of a broach or other applicator, permitting it to be carried even into the canals of upper teeth without difficulty. The acid does not materially affect a broach, and if any of it accidentally gets on the enamel of the crown of the tooth and is not noticed for a time, it does not decalcify and whiten the spot to the extent that sulphuric acid would do. When the acid is worked through the end of the root, as is desirable for cauterization in cases of a dental granuloma or alveolar abscess, it is sufficiently cauterant for the purpose desired, yet not as destructive as sulphuric acid would be; and owing to its analgesic tendencies, causes less pericementitis. In this connection, however, I want to say that we should not expect to do this work as it must be done without more or less soreness following the treatment. There is a wide variance in patients regarding the reaction of the periapical tissues to these agents, and in these chronic conditions it generally is best to invite and create inflammatory reaction that the sluggish cells in the area may take on new life and activity. This should not be done, however, at the expense of unnecessary destruction of tissue.

Technic of Using Acid Method: We now will consider the technic of treating pulpless teeth and preparing the canals for filling by the acid method. I take it to be thoroughly understood that good root-canal work means the use of the rubber dam in all cases, and the strict observance of asepsis. With me at this time, as heretofore, it means asepsis fortified by antiseptic precautions. I make this statement because it is so difficult to observe strict asepsis in our dental offices.

In a large percentage of cases of gangrenous pulps or imperfectly-filled canals, the radiograph will disclose a dark and suspicious area at the end of the root. With this evidence and under the conditions, we may properly diagnose the case as a dental granuloma or alveolar abscess. This growth may be nonpurulent or of the pus-discharging variety. It is recently only that these nonpurulent growths—true dental granulomas—have been recognized as such, and the treatment of such conditions in the past has not been as specifically emphasized as their significance merits.

Nonpurulent Variety: It makes no difference with me whether this growth is associated with a tooth, the canal of which contains a gan-

grenous pulp, *per se*, or an imperfect root-canal filling—the treatment is practically the same. At the first sitting when the diagnosis is made by the aid of a radiograph, or even before the latter is obtained, under aseptic precautions, the pulp chamber is opened into freely and a dressing of formocresol is hermetically sealed in and allowed to remain for two or three days. This treatment is for the purpose of neutralizing the gangrenous contents of the canal, or, in a measure, sterilizing the old root filling, as the case may be. In making an attempt to work one's way by chemico-mechanical means to and through the root-end without the previous application of some strong disinfectant, like formocresol, I have found that acute symptoms too frequently develop. This initial formocresol treatment prevents many of the acute symptoms which follow the immediate attempt to reach the root-end, however careful one may be. At the second sitting I want the radiograph; then with the rubber dam always in place and all necessary instruments sterilized, I carefully work to the apex with phenolsulphonic acid, using in connection therewith fine, smooth, twist and file broaches. This is what I call the chemico-mechanical process. Unless the canal is unusually small the work is begun with a fine twist broach—the kind which is rotated between the thumb and fore-finger. The pulp chamber is flooded with the acid by dipping the closed beaks of a pair of pliers into the liquid and carrying the same to the cavity; when the beaks are opened the acid is deposited. Before putting the pliers on the table the acid should be neutralized by dipping the beaks into a solution of sodium bicarbonate. This always should be done with every instrument used in connection with the acid, whether pliers, broach or other instrument. When I made the statement that phenolsulphonic acid did not materially affect instruments, I meant to have it understood that the acid on the instrument should be neutralized before laying it aside. One always should begin exploring the canal, even when known to be large, with a small broach. Where the twist broach may be used (which is in most cases) it serves me best. The gradual twist or auger movement carries the point forward and the grooves permit the acid to follow up or down the canal as one proceeds. This is another advantage which a liquid possesses over pastes or semi-solid substances. In this manner the end may be reached safely without danger of pushing the contents of the canal through the end of the root. In no instance should the broach be permitted to bind in the canal. Should this happen it either is too large or the canal is curved. To negotiate a curve, the broach should be curved to conform to the canal, as shown by the radiograph; then, with plenty of acid in the canal, it may be pushed gently past the curve and, in time, to the root-end. When the end is thus reached, a larger sized broach may be used; then still larger until one is able safely to use a barbed broach. When the canal is opened to the end, I like to use barbed broaches with a filing motion. This, with the acid,

rapidly cleans and enlarges the canal. As the work progresses the acid is neutralized frequently with a solution of sodium bicarbonate, and since phenolsulphonic acid is the chemical I am using, I prefer not to have the alkaline solution more than ten per cent. in strength. The sodium bicarbonate solution not only chemically neutralizes the acid but the effervescence caused by the reaction aids materially in removing the "mushy" and disintegrated material from the canal. I now use the acid and neutralizing solution alternately in the canal several times. First I enter and go to the end with the acid carried on a cotton-wrapped broach; then the sodium bicarbonate solution is applied in the same manner, keeping up the alternating process five or six times. After I am satisfied that I am at the end of the root, that the acid is neutralized and the canal perfectly clean and sufficiently enlarged, then, if the radiograph has indicated a periapical involvement, with the acid and a small, stiff broach (the apexographer as a rule), I work my way through into the affected area. Some of the acid is purposely worked through the end for the express purpose of destroying the growth by cauterization. When this is done, the acid in the canal—not that which has passed through—is neutralized with the sodium bicarbonate solution, the canal desiccated with *modified alcohol* (seventy per cent. alcohol to which one gr. of thymol is added to the fl. oz.), and a dressing of eucalyptol compound (very little on the cotton) is sealed in the canal. This remedy is used here because it is a stimulating antiseptic, but it also aids in hermetically sealing the canal, which is done at this time by using a combination of a good grade of temporary stopping and cement. The heated stopping is placed immediately over the eucalyptol compound dressing and it adheres firmly to the walls of the cavity; the excess is removed and the remaining portion of the cavity filled with cement. This dressing is left for a period of from four days to a week when, if the case has progressed nicely, and pericementitis is absent, the canals are filled.

I desire to give a word of caution here in connection with this work which I never have heard mentioned, and that is to guard against making the opening through the cemental end of the root unnecessarily large. This is an important essential and must be observed if ultimate success is to crown our effort. I do not care how large the canal is through the dentin proper; I hope it is constricted as it passes through the cementum. In fully erupted teeth this usually is the case. As Noyes, Callahan and others have shown, there may be two or more of these small openings—multiple foramina, as they are called. Unless the root-end and apical tissues are involved to the extent of necessitating surgery after the canal treatment and filling, the smaller the opening through the cementum the more certain we can be regarding the success of our root-filling operation; and even where surgery is indicated, nothing is gained by having the opening unduly large. We never should

lose sight of the fact that after the canal is opened it must be filled; and I repeat again, the larger the foramina the greater the hazard and the more uncertain will be the root-filling operation.

Purulent Variety: The treatment of an alveolar abscess of the purulent or discharging variety is practically the same as previously outlined except that in these cases there is not the danger of acute symptoms arising; therefore, one may safely, under aseptic precautions, work to and through the root-ends without the initial formocresol treatment. However, even here I believe it is the best practice to use formocresol first, but it is not so essential as in the case of nonpurulent growths. After we are through the end of the root it is best first to force a physiologic salt solution through the sinus, and if no sinus is present it generally is best to establish an opening through the overlying soft tissue and process, then cauterize the tract with some stimulating cauterant. Here also I use phenolsulphonic acid, full strength, as was used above for reasons mentioned. After this the treatment is the same as previously given for a dental granuloma. We never should lose sight of the fact that in all therapeutics we should work *with* and not *against* nature. If, in these cases, the root-end can be put and kept in such condition that the surrounding tissues can lie in physiologic contact with it, regeneration is effected; if this biologic condition cannot be brought about, all medication fails and surgery is the only road to success.

Pulps Partially Alive: In those cases where the pulp tissue is gangrenous in one or more canals of a multi-rooted tooth and alive in the other one or two canals, as the case may be, we will find much satisfaction in using the formocresol remedy. These are exceptional cases and it is difficult to know whether this condition exists until the second sitting. If there be much vitality in the live pulp tissue, the formaldehyd in the remedy doubtless will make the tooth ache, but after we know the condition our method of procedure is simple and the results will be certain. A small pledget of cotton dipped in the remedy can be placed gently over the mouths of the canals which contain gangrenous material, and a thin quick-setting cement flowed over the cotton. After the cement has set, the live pulp generally may be desensitized and removed with very little pain by gently working phenolsulphonic acid up and down the canal with a fine broach. Formerly these were difficult cases to treat, but with a remedy which can be sealed hermetically in a gangrenous canal, the procedure is materially simplified.

Pulpal Abscess: It was mentioned previously that one may open occasionally into a suspected tooth having all the symptoms of a dead pulp, and find a drop of pus in the bulbous portion of the pulp chamber with the remaining portion still alive. Some writers call this condition a septic pulp or pulpal abscess in contradistinction to gangrene or true

putrescence (presence of gases). In such a case any remedy containing formaldehyd may cause the tooth to ache; therefore this must be taken into consideration and in the treatment of so-called septic pulps the pus should be washed out of the cavity with a warm antiseptic solution, the cavity dried and asepsis established by hermetically sealing in a much smaller amount of formocresol than that generally used in cases of true gangrene. If this precaution is taken the tooth will not ache long, even in cases where no odor is present and the vital tissue still is quite sensitive. This remedy will sterilize the tissue, after which, at the second sitting, the pulp can be anesthetized or devitalized as usual.

Removing Old Root Fillings: In those cases where a previous attempt has been made to fill the canal with gutta percha, it is necessary, after the initial formocresol treatment, to remove first the old root filling. Generally in these cases there is only one cone in each canal, in which event the acid soon will work its way quickly around the cone, when it may be loosened with a suitable instrument and removed in one piece. However, occasionally it becomes necessary to remove a filling where the gutta percha has been packed firmly in the canal. Here the use of xylol, or xylene, as it also is called, will aid materially in disintegrating the gutta percha. This is dimethylbenzene, and while the agent does not dissolve the gutta percha in the sense that chloroform would, it readily attacks and disintegrates the material, making its removal comparatively easy after a few minutes.

Removing Blockade in Canal: We never should use any drug or chemical blindly. Therefore, if in working up or down a canal we find it blocked and are unable to reach the end, instead of going on blindly using only one chemical, whatever it may be, and running the risk of making a false pocket, we should stop and ascertain, if possible, and it generally is possible, the nature and character of the material causing the blockade. It may be only a curved root; it may be a remnant of an old gutta-percha cone; it may be pulp tissue undecomposed which has been packed inadvertently in the canal; it may be some inorganic material, such as a pulp nodule, secondary dentin or other loosened inorganic material which has been pushed into the canal. If we discover a curved root our broach should be curved accordingly; if we have reasons for concluding that an old gutta-percha filling is causing the blockade, xylol is the chemical to use; if we think it is organic material, the alkalies, like sodium and potassium or a strong solution of one of the hydroxids of these metals, is indicated; if inorganic material, phenolsulphonic acid or sulphuric acid will best answer our purpose. My plea is not to become wedded to any one chemical or method. Be eclectic and take the necessary time to do this work carefully and well. It is the most important work you have to do.

Filling the Canals: We now have treated these various conditions associated with pulpless teeth, the canals have been cleaned and en-

larged and the tooth-structure sterilized. There remains one essential thing yet to be done in the field of therapeutics before turning the patient over to the operative dentist, and that is so to fill the canals that *sepsis never may recur*. There has been a great variance of opinion in the past regarding the methods and materials used for filling root canals. The method employed in this operation depends largely upon the material which the individual operator uses, and a great variety of materials have been suggested and used, among which the following may be mentioned: Medicated cotton, medicated pastes, zinc oxy-chlorid cement, paraffin and gutta percha.

In the light of our knowledge today of focal infection it would be fortunate indeed if it could be correctly stated that all of the materials above mentioned, except gutta percha, had been discarded; for all, with the one exception, have been tried and found wanting. The radiograph has proven the correctness of this statement. In the opinion of the author, which is shared by men like Rhein, Black, Callahan and others, gutta percha modified and used in such a manner as best to meet the needs of the individual operator is the only material at our command today upon which reliance may be placed. From experiments made, Price is even skeptical regarding gutta percha on account of its inherent tendency to shrink; but against his laboratory experiments stands the record of thousands of clinical cases which proves conclusively that this material properly used answers our every purpose for filling the canals of pulpless teeth. This being true, the proposition resolves itself into the problem of determining the best method of modifying and using the material.

We may modify the properties of gutta percha by incorporating within its substance certain drugs; and drugs are added to root-filling materials for two purposes: One, a *pharmaco-mechanical* reason; the other on a *therapeutic basis*. In the case of gutta percha, it is admissible to add to and use in connection with the material such drugs as chloroform and eucalyptol for pharmacal and mechanical purposes. In the opinion of Callahan, even rosin may be added on this basis. The solvents, chloroform and eucalyptol, soften the material which permits its adaptation, by proper manipulation with heat and instruments, to every irregularity in the canal which has been cleaned and opened by the previous treatment—thus the latter is completely filled with a non-absorbable and, if properly manipulated, I believe, nonshrinkable material.

Whether or not we are justified in adding drugs to root-filling materials today for therapeutic purposes is a debatable question. Speaking of the use of the many so-called "permanently antiseptic" root-filling pastes of various kinds that have been advocated and used, Best says: "The only possible excuse I can see for the use of these

preparations in the roots of teeth is that the operator knows that he has left something in the root which he should not have left, and instead of removing it he places his 'life-saver' in on top of it and then rests assured he 'will have no further trouble' from it in the future." When we remember that to which the author has repeatedly directed attention, viz., there is no such thing as a permanently-antiseptic root-filling material, we cannot rightfully have this satisfying assurance. That gutta percha aseptically introduced in an aseptic canal will remain aseptic for years is the firm belief of the author and others, based upon years of clinical experience and observation. We have no right to fill a canal of a tooth which requires an antiseptic, as such, in our filling material. Referring again to Best, he makes the statement "that the only solution lies in an almost entire nondependence upon antiseptics in canal fillings and in the maintaining of asepsis in the operation." I fully agree with the first part of the statement that we should not depend upon antiseptics as such in our root-filling material; but I firmly believe in the liberal and generous use of antiseptics, and in the careful and intelligent use of disinfectants in establishing and maintaining asepsis in treating pulpless teeth and preparing the canals for filling.

Maintaining Asepsis: The responsibility of having all instruments and material used in dental surgery sterile, *where it is possible to cause an infection through an open wound or otherwise*, is rightfully thrown upon the dentist; and in assuming this responsibility he should study carefully the various methods of sterilization, and exercise judgment in his application of the principles involved. Therefore, in the filling of root canals the rubber dam always should be adjusted, and the teeth included sterilized, *for asepsis must be established and maintained*. In our work up to this point we have been using antiseptics and disinfectants—thus fortifying our asepsis. But now we should depend only on absolute measures. The canals should be aseptic before the operation is attempted. If there is any doubt in this regard the operation should be deferred until they are in such a condition. Not only should the canals be sterile, but all instruments and material used should be germ-free. Such instruments as will not be thus injured may be sterilized by the *direct application of heat* from the flame of a Bunsen burner or lamp by holding them in the flame, or playing the latter over them a few times. Other instruments may be sterilized by *moist heat*, as hot water or live steam. Cotton wrapped on broaches, absorbent points, and such other necessary material may be sterilized by *dry heat*. To sterilize the gutta-percha points it is necessary to rely upon *chemic agents*. These may be sterilized when first purchased by immersion for a few hours in modified alcohol or other suitable disinfecting solutions, when they are removed and placed on sterile gauze to absorb the liquid, then dried and put in gelatin capsules, Petri dishes or other sterile containers. Even with this method of keeping the points, it is

well to place the selected ones in modified alcohol a few minutes before they are used. Though it may be done, it is impracticable to sterilize the hands and keep them germ-free throughout the operation; and it is not necessary to have them absolutely sterile if the cotton on the broaches was sterilized by dry heat after being wrapped, as first suggested by Best. This is the safest practice.

Technic with Large Canals: If the author's suggestion has been followed in regard to using eucalyptol compound for the final dressing in treating pulpless teeth, the canal generally will be in condition to fill, so far as moisture is concerned, when the dressing is removed. Black states that "moisture is effectively removed by flooding the canals previous to filling with eucalyptol or oil of cajuput. The oils have a greater affinity or attraction for the dentin than has the moisture; therefore, displace it." If testing with sterile cotton on an absorbent point indicates moisture in the apical end, it should be absorbed before attempting to fill the canal. Over-drying with heated air or instruments should be avoided.

With these large canals, especially those in connection with which dental granulomas or alveolar abscesses have been treated, where the apex is large and where we ought not to expect to get a response from the patient when the gutta percha reaches the apex, on account of the loss of tissue in the periapical area, it is best before filling to measure the canal and then use one cone which approximately fits it rather than to use two or more smaller cones with the possibility of unnecessarily forcing one through the apex and into the periapical area. To measure the canals, absorbent points may be used. When, after repeated trials, we find a point which fits the canal, a cone should be selected which is slightly larger than the measuring point. The canal now should be moistened with chloroform, carried to place by the long beaks of a pair of pliers, then a small amount of eucapercha introduced, the latter being worked up or down into the canal with a fine smooth broach, exhausting the air. This accomplished, the selected cone, flattened on the large end, should be held in chloroform for about thirty seconds and placed in the canal, when it should be worked up and down a few times with a slight pumping motion. In this manner the chloroform and eucapercha soften the outer surface of the cone, leaving the central portion with sufficient resistance to cause the mass of gutta percha to spread laterally as the cone is finally pressed to place with the pliers. Root-canal pluggers now may be used and the mass of gutta percha firmly packed in the canal. If chloroform is used, very little heat is required to soften the cones. The final packing may be done with a tampon of cotton or Japanese bibulous paper, saturated with chloroform, as suggested by Rhein. In filling large canals from which live pulps recently have been removed, the patient generally will flinch before the cone reaches the

apex. When this occurs, we should wait a few moments, when the cone can be pressed gently much farther without causing the patient to flinch a second time. If these precautions are observed they will be the means of preventing much of the pericementitis following the filling of root canals.

In these cases we should make every endeavor to have our sterile root filling reach at least to the end of the root; and Rhein repeatedly has emphasized the necessity of encapsulating the apical end of the root with the fluid gutta percha in all cases where gangrenous canals have been treated which in any way involved the periapical tissues. The author believes the future will prove this to be necessary in cases where dead and infected pulps have been treated. In clean cases it is not necessary for the filling material to protrude beyond the apex. In my opinion it is sufficient if it reaches the junction of the dentin and cementum, though it is difficult to fill canals as they must be filled for success without having the material pass through the apex to a greater or less extent. Fortunately, the tissues take kindly to sterile gutta percha. However true this may be, I do not want more of the material to go through than enough to guarantee the thorough filling of the opening and the encapsulation of the root-end. With a small opening this is accomplished easily; with a large one it is not. As yet I do not know the fate of a large mass of gutta percha protruding through the root-ends of teeth and occupying a portion of the area absorbed by the necrotic process. I have some of these cases in my practice now under observation, where it was impossible to fill the canal as it must be filled without pushing the root-filling material through into the apical area farther than I should like to have done. I will report on these cases later when time and the radiograph will have shown the results.

Technic with Small Canals: In filling all canals where we can enter nicely with a small canal plugger, it is best to follow the technic previously given, using a cone which will enter the canal. However much we may regret it, there are canals so small and tortuous that only a fine, smooth broach will enter, at least to any depth. It is useless to try to fill such canals with a gutta-percha cone. The various methods of enlarging the canals by the use of acids and alkalies can be employed, but it is not always advisable to enlarge them sufficiently to admit a cone of any appreciable size, and there is no resistance to a very small cone, especially after it has been softened with solvents or heat. After the larger canal or canals in a multi-rooted tooth are filled in the ordinary manner, the smaller ones can be moistened with chloroform and eucapercha and the solution worked up or down into the canal. This process should be kept up for some time until the chloroform evaporates, leaving the gutta percha rather thick and quite plastic. The sides of the pulp chamber now can be moistened with eucalyptol

compound and a piece of base-plate gutta percha, selected and softened in the flame, can be packed into the pulp chamber, when pressure is made toward the small canals and the plastic gutta percha forced into them. This is much better practice than simply filling the mouth of the canal with a gutta-percha cone, leaving the rest of the canal empty. It will make no better root-canal filling, but you may be better satisfied with your subsequent radiographic findings if, in these cases, you add some barium sulphate or bismuth subnitrate to the eucapercha before introducing it in the canal.

If the canal is so small and tortuous that even a small broach will not enter, and if it cannot be enlarged by the use of acids or alkalis, it will be necessary to either extract the tooth or record the fact and occasionally check up on the case with a radiograph to ascertain if any infection is present at the end of the root. In every case where it can be done, the gutta percha in the canals should be protected by zinc oxychlorid cement. This may be done in all cases except those where it is subsequently necessary to insert a post in the canal for some purpose.

The technic of filling root canals with gutta percha, as described by different operators, varies slightly, as, for instance, in the drugs used as solvents and in the manner of introducing and packing the material in the canal. Some operators believe they can get a more compact mass of gutta percha in the canal by cutting the points and introducing them in small pieces. Whatever method is employed, the gutta percha must be left firmly packed in the canal, and it is the duty of every dentist to use this material in filling root canals according to the method which offers the greatest opportunity for success in his hands.

The operation is one that requires attention to detail and, while the author does not believe it necessary to radiograph every root filling, a sufficient number should be radiographed until the operator is satisfied he has mastered the technic of the method employed. All difficult cases and questionable root fillings should be radiographed. In treating pulpless teeth, preparing the canals for filling, and in the root-filling operation, the dentist always should try to do his best; and it is well to remember here that we fail with the problems of life only when we lose confidence in our ability to succeed.

In recent years much has been written about the health value of removing focal infection. This is all important, but I wish to state, with all the emphasis at my command, that the majority by far of teeth thus involved may be therapeutically or surgically treated so that they will not be a menace to the health of the individual. Physicians and dentists should work together and in harmony on this proposition. The former should not advise the extraction of teeth without first consulting the latter. When focal infection is found or suspected in the mouth by the medical practitioner, his plain duty lies in referring the patient

back to the family dentist with such suggestions as he may deem advisable in the case; and the dentist's duty lies in removing the *focus of infection* by treatment or extraction. The members of the two professions should work together harmoniously for the benefit of the patient's health, which, I am happy to say, is being done today.

"Honor and shame from no condition rise;
Act well your part—there all the honor lies."

OUR NEXT STEP—ADVANCE OR RETREAT?*

BY L. P. BETHEL, M. D., D. D. S., COLUMBUS, OHIO.

AS WE LOOK BACK a few years and trace the progress of dentistry, we are impressed with its great development. Yet, great as it has been, it seems to be but a beginning of what must come. The greatest knowledge, ingenuity and skill of our dentists will be tested by the problems and obligations of the new era that has dawned for the dental profession.

In the past, dentists were looked upon as mere mechanics, especially by the medical profession; and it was not until dental science was so developed that it began to overlap medicine, that the medical profession awoke to the realization of what dentistry really means to the welfare of the human race; and to what it often means to the success of their own operations and treatment.

Some time ago Surgeon A. M. Fauntleroy, of the U. S. Navy, made a report on the "Medico-Military Aspects of the European War." In this report the author referred to the commendable work that the dental surgeons were doing in the hospitals, and he mentioned particularly that done in the dental department of the American Ambulance in Paris. Among other things he said:

"One of the surgical advances of the present war has been the recognition of the dentist as a necessary unit in the organization of a military hospital. So valuable has this work become that every large military hospital now has its surgical dental department, which works in conjunction with the other surgical services and supplements certain procedures which are indispensable as regards bringing about a favorable result."

After enumerating many operations performed by the dental surgeons he continues:

"There can be no question of the value of placing the teeth in order, as shown by improved digestion and general good health following this work; but

* Read before the Mid-Winter meeting of the Rehwinkel Dental Society and the Eighty-third Division Dental Society, U. S. N. A., at Camp Sherman, Ohio, February, 1918.