

sible completely to sterilize all the dentin, but the inner exposed area can be freed from bacteria after mechanical cleaning and treatment and then the canal should be thoroly filled with gutta-percha.

FOLLOWING UP.

The case should be recorded with all the data concerning each tooth in regard to condition presenting, treatment used, method of filling, and radiographs. At intervals the patient should be sent for and radiographs made to show the progress of the recovery as well as to insure the patient against any further development of trouble at the root end. If operators will adopt some uniform method of recording and following up, it will be of inestimable value to the progress of this line of work.

The problems involved in the treatment and filling of root-canals are both mechanical and bacteriological. Perfect mechanical filling, after careful treatment with antiseptics which will not injure the periapical tissue, will show very gratifying results and I feel confident that the future will reveal a very large percentage of success in all cases so handled. The natural tooth is not to be compared with an artificial substitute for comfort and usefulness when it can be saved without jeopardizing the patient's health; and by following these cases along by means of radiograph for a few years and recording the condition about the root end, we shall soon be able to state with more clinical proof that such treatment is successful.

REFERENCE.

1. Journal of American Medical Association, October, 1918.
2. Special Dental Pathology.—Black.
3. Dental Materia Med. and Therapeutics.—Prinz.
4. American Journal of Clinical Medicine, September, 1918.

DISCUSSION.

John E. Nyman: Whether or not to allow a pulp to remain, is often a perplexing question, but if the continued

vitality of the pulp is dubious, it is wiser to devitalize and fill the canals under aseptic conditions.

Altho the radiographic examinations shown by the essayist are encouraging, it must be remembered that radiographic evidence is not final. I cannot help feeling that the conclusions drawn by the essayist are optimistic conjectures rather than certainties. Frequently, coincident with the destruction of the cancellous bone structure will proceed a sclerosis of the cortical region which gives sufficient radiopacity to conceal full evidence of an infected cavity behind. On the other hand, radiographs may seem to show but a partial root filling, where as opening up the canals shows them apparently filled to the apex. The explanation in some cases is that the foramen is located, not at the apex, but on the side of the root, as far as 2 mm. from the apex, and that this abnormal location, when on the labial, buccal or lingual side, is not betrayed in the radiograph.

Results obtained by the use of the faradic or galvanic current must be controlled by radiographic evidence, for occasionally we find, in teeth with multiple roots, that one root will be devitalized while the other is vital. I have found that viewing the film in front of a strong light, thru reversed opera glasses, brings out the infected areas more distinctly.

For pulp removal, I prefer regional and pressure anesthesia for immediate removal, and for gradual pulp extirpation the use of arsenic paste, in the manner advised by the essayist, followed by pressure anesthesia after counteracting any free arsenic trioxid that may be left. No useful drug should, I think, be condemned because careless or injudicious use makes it dangerous.

Diseased pulps give rise to our greatest problems. Whatever the evidence given by the radiograph, we may be sure that when opening the pulp chamber re-

sults in a discharge of foul gas and pus, the condition must be met with surgical procedure.

As therapeutic agents in addition to those mentioned by the essayist, I find use for arsenic, sulphuric acid, potassium, sodium, and other drugs of great chemical power.

In acute infection, I think we are more successful when we simply open the pulp chamber and leave it alone until later on when the swelling and soreness have disappeared and the operator can give the tooth the time it requires for antiseptic treatment.

As to aseptic measures, I sterilize my instruments and cotton points with dry heat, and never insert a broach in a root-canal without first dipping it in 70% alcohol. The gutta-percha points are sterilized by immersion in alcohol to which 5% iodine crystals have been added.

Opening the canal to the apex offers the greatest operative difficulty today. We cannot escape the fact that we often have to use drugs that will dissolve the contents of root-canals, because, owing to abnormal anatomy, we cannot penetrate the canals with any broach.

As to ionization, Dr. M. L. Ryan is of the opinion, I think, that his best therapeutic effects are secured by the formation of a chloride of zinc solution. Ionization frequently stops a discharge from the canals, and subsequent radiographs show a radiopacity that suggests that the cyst has disappeared and new bone has formed in its place. The explanation is probably that the bone cavity has been filled with a coagulum from the chloride of zinc, which is not easily broken down or infected by bacteria. If the canal is pumped full of chloropercha, followed by gutta-percha points, the bone cavity will always fill up with the chloropercha solution.

Root resection, I believe, lies in the realm of what we might call conservative surgery, whereas tooth extraction be-

longs to destructive surgery. The root of a lateral incisor, with a history of a number of years of infection, which I resected fourteen years ago, disclosed no infection in a radiograph a week ago and was firm in the mouth. There had been no recurrence of the discharge and there were no signs of the systemic effects of an enclosed infection.

As to the technic of root resection, the apical section of the root-canal is filled, but whether or not is filled quite to the apex I do not care. Then the root-canal is reamed out as far as possible with a No. 3 or No. 4 root-canal plugger. This section of the root-canal is filled with copper amalgam, for, as one cannot cut across a gutta-percha root filling without dragging the gutta-percha away from one side of the root-canal, it is necessary to have a copper amalgam root filling at the plane of resection. Root resection sometimes fails because of residual infection lodged in irregular tubuli and lacunae. Therefore, I paint the resected root surface with a strong solution of silver nitrate. The bone cavity is then washed out with an aqueous solution of iodine. A blood clot is allowed to form, and the incision flap is sewed together. Radiographs of these resected areas, it must be admitted, are not encouraging. There is always shown evidence of an apparent infection and rarefaction of the bone tissue, probably due to the fact that the secondary bone tissue does not organize so completely as the original tissue.

In regard to the extraction of teeth with infected apical areas, it is necessary to recognize that the operator may not cure the disease by mere extraction. Grave infections in the neck, in the sublingual region, in the submaxillary region, and in the antrum sometimes result. Part of the cyst may remain, and this part, closed over, may begin the formation of a monolocular or a multilocular cyst, and result, possibly, in a pathological fracture of the jaw and even the loss of a section of the jaw from pressure

necrosis. To prevent these infections, the socket of the extracted tooth must be thoroughly curetted, swabbed out with iodine solution, and packed with iodoform gauze saturated in compound tincture of benzoin. The socket is usually packed three times at intervals of three days.

In curetting in the lower molar region, one should be very careful not to invade the inferior dental canal, which sometimes lies very near the apices of the lower first molar. Like care should be taken in curetting in the region of the upper first molar and the bicuspid not to invade the floor of the antrum. It is better to allow any leakage from the first molar into the antrum to drain naturally than to break into the floor of the antrum with the curette, for chronic fistula may result. If necessary later, one may operate from the region of the canine fossa, for chronic antrum infections invariably involve the anterior inferior angle with its mass of honeycomb cells. Until these are cleaned out, a chronic antrum case will never clear up.

A. D. Black: We do not know the causes of chronic alveolar abscess. We know it follows the death of the pulp, but we do not know how many should be charged to those changes which take place within the dead pulp tissue, and how many to other causes. Dr. Coolidge was kind enough to refer to some work that I have been doing in the study of these conditions. I reported the examination of radiographs of some 1500 root-canal fillings, which showed about 9 per cent. of failures in those cases in which the fillings appeared to have been well made, and about 63 per cent. of failures in cases in which the root fillings were poor. These were not my own root-canal fillings, but were examinations of radiographs which were taken under my supervision, the large percentage of them being full sets of mouth radiographs of members of the senior classes in Northwestern University Dental School during

the past few years. They represented a very wide range of operators.

I wonder how many of us know how many pulp cases we treat in a year. I have a record of every one since I have been in practice and of every separate treatment. I had my assistant count up today the number of cases in which I had removed vital pulps or dead pulps from July 1, 1917, to July 1, 1918; the record showed the removal of 51 vital pulps and 9 dead pulps. I do not know whether these figures would be above or below the average, but I am quite certain that each of you would greatly overestimate the number of cases you treat, unless you have made actual count. I call attention to this because some men have hesitated to undertake more thorough root-canal operations on account of the greater time required. There are not so many but that we should be able to give them all the time that is necessary and I can think of no more valuable service.

I have felt for some time that we were not going to get the real facts which we need in the study of this pulp problem without having the cooperation of many practitioners in the collection of thousands of good case histories. I have had three lantern slides made that I want to show tonight to illustrate a simple means of keeping the record of pulp conditions, the diagnosis, the treatment and the subsequent inspection. I present them solely for this purpose and I hope by this presentation to gain the interest and cooperation of a good many members of this society and of other societies, so that within a few years, we may have tabulated enough case histories to serve us as a basis of more rational consideration of this condition. The particular plan that I am presenting is one that Dr. Coolidge and I have worked out together.

(Dr. Black showed lantern slides of a case history sheet on which a complete record of diagnosis, treatment, and subsequent radiographic examinations could

be made by simply entering an X or the date, each time the patient presented.)

Dr. Coolidge spoke of blood counts in connection with the radiographic studies. We are making blood counts in all cases where we take full mouth radiographs, and we are getting some very interesting information. A large number of cases have presented either periodontal or apical infections with a white cell count of ten, eleven, or twelve thousand. Of course we are following up as many as possible of these cases with subsequent blood counts. It will require a large number of these before we are justified in drawing conclusions.

In connection with testing with the faradic current, it has been my custom to take a piece of rubber dam and slip it over each tooth separately as I test it. By this plan the transmission thru fillings to proximating teeth is avoided.

These radiographic illustrations of the changes which take place in the bone following root-canal filling or root amputation are very interesting. However, I cannot help feeling that a good many of us are getting away from the basic things as we examine these radiographs. It is of very little account that we have radiographs showing large abscess cavities within the bone and subsequent radiographs showing that these cavities have filled in with bone afterwards. We should naturally expect the bone to build in when the source of the infection is eliminated, but that does not necessarily mean that the menace to the individual is removed, or that there has been complete healing.

Dr. Coolidge called attention to the building in of the bone about the roots of the teeth and the showing in subsequent radiographs. His observation agrees with my own as reported to this society a year or two ago; namely, that in cases in which the bone did build in about the end of a previously denuded root and we thought we had a very happy result, the radiograph taken six months

later often showed a cavity in the bone, meaning that the bone had been again destroyed. What does that mean? It means that we had eliminated the original source of infection and that the bone which filled in the cavity did not attach to the root of the tooth, but that there was serum between these two which became infected and that the bone was destroyed again. That is a thing to be expected. We must come back to the basic fact stated by Dr. Coolidge tonight, that when the cementum is denuded by suppuration, there will be no re-attachment, and the condition is not safe. For the same reason I think ionization is a failure in these cases. Neither would I recommend forcing gutta-percha thru the end of the root. That only obscures the situation. The preceding speaker stated that he left these teeth in if they gave the patient no discomfort in mastication. I hope we have gotten past that in the practice of dentistry. If we recognize the relation of these foci of infection as a real menace to the health, we must eliminate every such focus. We cannot permit such teeth to remain in the mouth even tho they are comfortable and serviceable for mastication.

A. H. Mueller: Dr. Weston A. Price, in his last report of the National Research Institute, said that we have two drugs which will absolutely sterilize diseased and infected root-canals; namely, iodine and silver. Silver salts give an ugly discoloration to the tooth even thru the gum tissue; but, generally, as Dr. Coolidge has said, iodine does not do this, and even if it does, it can be bleached with sodium hyposulphite, after it has sterilized the canal.

Another thing that Dr. Price gave us is the use of resin and chloroform as root-canal filling material. He showed that resin dissolved in chloroform will penetrate all crevices of the root-canal, and in that way seal up all the foramina. He advised the use of these in conjunction with gutta-percha and chloroform.

I am able better to fill all root-canals by this technic. I believe that iodine will go to the extremities of the root-canal just as a drop upon the finger will go thru all the crevices of the skin.

The difficulty, which sometimes occurs, of getting iodine to go to the end of the root-canal of an upper tooth, can be overcome by wrapping a little cotton firmly around a broach and pumping the iodine up into the canal.

In the case of a tooth that has the pulp partially destroyed or partially dead, owing to infection, it is no longer necessary to use arsenic to destroy the rest of the pulp that happens to be humane, nor is it necessary to use 95% phenol, which is painful. Block off that tooth with a local anesthetic, apply a rubber dam, and flood the pulp chamber and canals with iodine. That will sterilize the canal in a few minutes; and the tooth, being anesthetized, one can then remove the fragments of pulp at the apex. This method has been successful in my hands. I like it better than arsenic, and better than phenol.

Knowing that we have two drugs that will absolutely sterilize root-canals, why not use them, and in this way overcome the doubt of a sterile canal and the necessity of taking a culture from the canal to determine the sterility of a tooth.

T. W. Brophy: In the study of this subject, we must not forget to take into consideration the general condition of the patient. If the patient has some specific disease which saps his vitality, such as tuberculosis, the operator will have little success in effecting the cure of an abscess formed about a tooth.

We must also consider the problem of sterilization. In the first paper I ever read before the Illinois State Dental Society—a paper on the treatment of exposed pulps—I took a position contrary to the opinion of a great many members of that society, and stood practically alone in declaring that chlorid of zinc in an exposed pulp would kill that

pulp. Oxymchloride of zinc was first suggested by Dr. William H. Atkinson in the seventies; he said all that was necessary was to excavate the cavity, place in it some oxymchlorid of zinc, and when it hardened, fill the tooth. I have filled root-canals with oxymchlorid of zinc, and have found that it sterilized them completely and that, following its use, abscesses occur but rarely.

Radiographs cannot be relied upon as the sole evidence for making a diagnosis. Skiagraphers who make diagnoses from their pictures and send written reports to the dentists, show bad judgment: they know nothing about the actual condition of the teeth. A careful examination is necessary in order to ascertain whether pathological microorganisms are actually present.

Dr. Coolidge (closing): There have been some very interesting things brought out in the discussion. I want to call attention especially to the charts mentioned by Dr. Black. I feel that they are just what we need to lead us to some definite conclusion. I agree with Dr. Black that we are just guessing at many of our conclusions. Each of us must be willing to do something along this line if we want to get anywhere in root-canal work. If we can have one hundred men in Chicago make records of this kind, in five years' time we shall have records to prove or disprove things we are guessing at now. For instance, we discover in the radiograph rarified areas in the apical region about the roots of teeth and begin treatment of those teeth, assuming that these areas are always infected. That is the only safe assumption. We cannot consider the cause of the rarified area but must treat it as an infected area. It may be arsenic or phenol or some other drug that caused the absorption. It may be a mechanical injury. It may be a pressure absorption. We cannot determine the cause of these absorptions until we get some records. I think

those records will show us many things that will aid us.

Dr. Dittmar: Why is it that sometimes we see those areas over the ends of teeth that presumably have healthy pulps?

Dr. Coolidge: The radiograph does not lie. It is simply the picture of an object as a shadowgraph. Where there is a dark area in the negative, there must be a hollow place in the object; otherwise there would be a uniform density in the negative. We cannot always tell what makes that hollow place. It is not always a pathologic condition. I reason that there is often an absorption of bone from some unknown cause or from some mechanical injury—such as the movement of a tooth under abnormal occlusal force—that leaves a larger hollow in one place in the alveolar process than in another. The alveolar process is not always uniformly dense. Such hollow spaces or areas may be found at the apex of a root or sometimes in the process away from the end of the tooth. But if it should occur at the end of a tooth that had a poor root-canal filling, we would look upon it as a pathologic condition. That is why I do not like to say that we must always resect such a root or extract the tooth.

Dr. Nyman said that my interpretation of my lantern slides was most optimistic and then went on to tell of his beautiful results from resecting the root, which do not show in the radiograph.

Dr. Nyman: I said I was perfectly willing to admit that there might be reorganization, but you showed radiographs so different that I did not feel you had eliminated the infection.

Dr. Coolidge: Getting uniform radiographs is a mighty hard thing to do. I can go over a whole mouth and get almost uniform radiographs. If that patient returns after a period of months I cannot get exactly the same radiographs either in position or density.

There are many things that enter into a radiograph that are difficult to control. If the machine is not working the same, there will be a little variance. When the radiograph is developed, there is a chance for a difference. When we have lantern slides made, there is another chance for a difference. Some of these lantern slides were made previous to this meeting. These lantern slides were all made by the same firm, but they are not uniform.

In regard to chloropercha not being opaque to the X-ray, I wish to say that such a statement is not entirely correct. I do not question at all that you can file down some roots filled fairly well and show chloropercha or gutta-percha in the root-canal farther than it shows in the radiograph, but you cannot depend on that. You have no evidence of a filling that does not show in the radiograph. We are going to do harm by assuming that the canal is filled if it does not show it is filled in the radiograph, because there are a great many men who are going to say, "The canal is not filled in the radiograph, but the chloropercha does not show, and so it is all right." A great many mistakes are going to be made on the basis of that statement I am afraid. If you extract and file down filled roots, you will find some are filled better than they show in the radiograph, but you do not know beforehand which cases; but when you can see it in the radiograph, you know the filling is there, and the more dense you pack it into that tooth, the more definite a shadow will appear in your radiograph. **The thing we are all looking for is good root-canal work, and we cannot accept a root-canal filling as a good filling that does not show gutta-percha to the end of the root-canal.** We cannot accept a root-canal filling as a fair filling unless the radiograph shows gutta-percha as far as the open space in that canal. Let us be careful that we do not advocate something that will help some

fellow to stop before he gets his canal filled as well as he can fill it. That same fellow may be one of us. It is just as hard for me to take a root-canal filling out and do it over again as for any one else.

I do not like to give a wrong impression on this problem of filling root-canals. I do not like to show lantern slides that may be questioned. I agree with the criticisms. They were all right. I expected them. From these radiographs, taken at various intervals of time after filling the roots of teeth and showing areas about their apices, I am trying to get some information by which to classify, as far as possible, the conditions that can be cured by treatment and the conditions that cannot be cured without extraction or resection, and trying to determine some line of distinction between these two classes of cases. It is difficult to do that. I do not know how we can do that until we have followed a long line of cases in similar conditions

that appear very much alike in the radiographs over a period of years. The proportion of those that are successful to those that are failures may show that some of these teeth can be permanently cured by treatment only. That will depend on the amount of cementum denuded and infected, a thing which is very difficult to tell in the radiograph. If that is true, the only way to proceed is to treat some of these teeth and watch them; and if the areas persist, to cut off the roots.

Just another word in regard to over-filling the root-canal. I do not like to do it. That has happened in many cases but I try to avoid over-filling. If I could just fill it full and stop there I would always do it. I try to do that by measurements. Some times a little of the gutta-percha goes thru. In my effort to fill the collateral branches I often get a little chloropercha thru. I try not to over-fill the root-canal, especially one with healthy apical tissue.