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The Relation of Dental Operations and Dental Lesions to Systemic Lesions*

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MEMBERS of the Toronto Dental Society, I assure you it is a great pleasure to come home. I always feel I am coming home when I come to Toronto.

We shall study together to-night three or four phases of this great problem of the relation of dental operations and dental lesions to systemic lesions. I will ask you to study with me first the relation of the medicament that we shall use in the sterilization of teeth to the results that are obtained with that procedure. I am very sorry that I cannot bring you a more encouraging and hopeful message so far as it relates to the procedures of the past. It has been a very great disappointment to us in making these researches to find that many of the things that we thought were so, are apparently not so. I say "apparently" because it is always within the range of possibility that there is some new phase of this problem we have not understood, we may not have made a sufficiently large number of experiments, we may not have checked our work carefully enough. However, we will leave it for you to be the jury, and I simply present to you the evidence as we have it, and you will make your own conclusions.

We were discussing at the dinner table this evening whether or not we are, any of us, free from the influence of superstition, when I suggested that one of the shocks that came to me recently, was to find that some fourteen thousand observations had been made to see whether there was any truth in the generally accepted phenomenon

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of mental telepathy, and that these demonstrate that the number of instances in which there was really a transference of any impression whatever from one mind to another, was precisely that which would be expected to occur according to mathematical chance. If now, a thing we have accepted so universally as that, is not based on fact, how readily it may be true that some of the things that we have much less evidence regarding may not be based on fact?

We have undertaken to study the relation of the tooth to the patient, first, then later, the relation of the patient to the tooth; and in this large series of experiments that we shall report, we have tried, if possible, to ascertain where the infection exists in dental structures, how the infection may be destroyed, what effect the various medicaments, we are in the habit of using, have. And as I stated we have been exceedingly depressed to find that so large a number of medicaments were practically worthless; which simply is another way of saying, we, as a dental profession, have been taking a great deal of credit to ourselves that should have gone to nature. She has accomplished the splendid results she has, not because we sterilized teeth, but in spite of the fact that we do not. That is really a compliment to nature, and it is a compliment to our bodies, and when we come to have that fact entirely settled into our systems, we will have a greater respect for our bodies than we had before, because we realize that if nature can do all of that in spite of some infection, how much better she will do when we are able to do our work without infection; however, that time probably will only come when we shall all be practising prophylaxis successfully.

THE RELATION OF MEDICAMENTS TO THE STERILIZATION OF TEETH.

We have undertaken first to determine whether or not the medicaments we are in the habit of using can sterilize an infected dentin and cementum under the most ideal and favorable conditions. We have therefore taken a large mass of medicament and a small quantity of tooth, relatively. In other words, we have taken our infected tooth and immersed it in a large quantity of medicament and allowed the medicament to attack the organism from within the tooth structure as well as from without, for in each case the medicament was pumped into the open canal, and the canal was always opened through the apex.

This is the report of Mrs. Mauldenhauer Brooks and myself on the medication of tooth structures which we gave at the National Association meeting in New York in November, and I want you to think of Mrs. Brooks as being the technician who did this work in detail under my direction and did it very efficiently indeed. It was published in the Journal of the National Dental Association issued about March 1st.

The first experiment I will report, took three thousand teeth opened through the apex in that way. The medicaments used were those in common practice, and I think something like 110 different solutions were used for the test. Many of these were different percentages of the same medicament; and I shall endeavor to show you how utterly inefficient these various medicaments are to sterilize tooth structure (even under the most favorable circumstances), and we will later see the great disadvantage they have to labor under when they are being used in the mouth.

I wish in the first series to call your attention to the fact that many of the medicaments act as depressants to the growth of the organism; they inhibit, we say, and they do not necessarily kill the organism, but they delay its growth. I shall ask you to note first the medicaments used: phenol, formaldehyde, iodine, chloral, etc. The number of teeth used in each case was ten. There were three series of cultures made, the first was a mixture in the mouth, the next was a pure streptococcus taken from the dentin of the mouth, and the third one a mixed culture. Note the number of hours: 24, 48, 72, 96, 120, 144, 168; then the eighth day, ninth day, eleventh, thirteenth, fifteenth day. Some of the medicaments held back the growth so that it did not appear until the seventh day. When we used series No. 2, which is the pure streptococcus, only one of the tubes was found growing-out on the fourth day, and on the sixth day two tubes, and as you go down through the series you find some growing-out even as late as the fifteenth day, showing you that the inhibiting effect of the medicament may last for days and days, and we may think we have a sterile condition, but it is not.

Then we have iodine and creosote, copper sulphate, iodoform, oil of thyme, hydrogen dioxide, oil of acacia, thymol, lysol, bichloride of mercury, etc. Now again we find many of these tubes growing-out late, as for example, oil of cloves, 25 per cent. solution, on the ninth day, again showing the marked inhibiting effect; and this again with oil of thyme on the ninth day. That inhibiting effect may be very misleading to us. For instance, if we had filled the tooth to which I have referred before the ninth day and had made cultures and had determined that our tooth was sterile because of the result of that culture, we might be misled into thinking we had produced a sterile condition when we really had not. Then you notice we have some growing-out on the thirteenth day.

Again when we come to eucalyptol oil and creasote we note the marked inhibiting effect, some of these growing-out on the sixth, seventh and eighth days.

Then we have the acids, hydrochloric, sulphuric and nitric, showing they did not have the inhibiting effect. With the acids the teeth were not saturated for the 24 hours. They were put in the solution of acid for a period of time (I think it was ten minutes for each tooth

approximately), showing that the acid had not in ten minutes' agitation in the canal destroyed the organism.

We have arranged the same information in a different form so that you can see the percentages. We put the acids at the top. There was a zero efficiency for the various cultures until you come down to phenol and the 24-hour group. The five per cent. solution showed 30 per cent. efficiency, 100 per cent. with pure streptococcus and 80 per cent. with the second mixed. Formaldehyde shows 100 per cent. in nearly all its strengths. That is important for you to remember, and even down to one per cent. Iodine shows greater efficiency at five per cent. than at seven; chloral, phenol, creosol and formalin show a high percentage; iodine and creasote not as high as we would have expected; chloral-hydrate shows a rather high percentage. If you go over the list you will see what a large number of them fall below 50 per cent.

Then in the next series we have arranged the same information in order of percentage efficiency only. We have first the various chemicals that produce 100 per cent. efficiency under ideal conditions for the medicament. At first glance you will be encouraged because you will think that represents the majority of the drugs, but as a matter of fact the majority are of zero efficiency, which are coming to. Under 90 per cent. three or four, eighty per cent. three, etc. In the next series they range from 70 to 50, 40, 30, 20, 10, and you will see at a glance many of your favorite medicaments in the low percentages, but I suspect more of them will be shown in the next series which will give you those with zero efficiency, and that is where the majority of them belong. The medicament had ideal conditions, because we had a large quantity of it, we saturated the tooth in it for 24 hours, (except in the case of the acids), and the quantity was large in proportion to the quantity of tooth structure.

We then took twenty of the best drugs of the 110 and made determinations to find whether or not the medicament could even keep a sterile dressing sterile, if the sterile dressing was put in an infected tooth. We took our sterile point, saturated it with the medicament, put it inside the infected tooth, when the tooth was not surrounded by an infected culture medium, and the result was that the infection from the tooth came out of the tubules and overcame the sterilizing effect of the medicament, so that the organism was actually found in the dressing. Our dressings were cut into four pieces numbering from the apex, and even without a periapical infection, creosol, creasote, formalin, concentrated phenol compound, and dichloramin-T, were the only ones that produced any sterilizing effects at all.

You next see the result of the difference between a five-hour, a twenty-four hour and a forty-eight hour treatment. You see how very much better it is to treat a tooth for 5 hours than for 24 hours, and it is worthless to treat it for 48 hours. If anyone will take the

trouble to use a little simple experiment, (for it was this thing that led me to have our Institute carry out this particular line of work), he will find it interesting, namely: put any dressing in any tooth whatever that is infected, and leave it in that tooth for 24 or 48 hours, and if you have the right culture, medium, if there is not a growth, from that root dressing material, you will have a different result from any results that I have ever gotten. I have never once removed a dressing from an infected tooth, where I had reason to believe the tooth was infected—and I think we can't have an infected tooth without having an infection beyond the apex to some extent unless the apex is entirely sealed—I say I have never once removed a dressing and cultured it, that had been in a tooth for 48 hours, that did not grow-out a live culture. So phenol compound left in the tooth five hours showed 70 per cent.; if left in for 24 hours, 15 per cent., and for 48 hours, zero efficiency, and so on with the different compounds.

We could spend the whole evening in discussing what that means to us. It means we must change our entire system of sterilization of tooth structure.

We then made a series to determine the effect when there was a periapical infection at the apex of the tooth; and to accomplish the result we sealed over the crown of the tooth with paraffin after placing our dressing, and placed the entire root, with a small opening through the apex, in a tube, containing an infected culture medium, so that the apex of the tooth was bathed in the infected culture medium, and in not one single instance did we get an efficiency that was worth reporting. Do you realize what that means? When we took 20 of the best drugs that we knew of and put them on dressing material, that that medicine could not even keep a sterile dressing sterile, when put in an infected tooth when the apex was surrounded by an infected culture medium.

We then undertook to ascertain how much of the tooth was made sterile by placing medicament inside of the tooth, and if you follow it through you will readily get in mind the areas we have taken the cultures from. We took these same teeth that had been treated in the above way, split them in half, took cultures from areas of the cementum by drilling in from the outside, then about a millimeter from the apex, drilling into the cementum. Again after splitting the teeth we went into the fresh surface of the dentin at the area near the apex, again a millimeter and a half or two millimeters from the apex, and again towards the centre of the root, and approaching towards the crowned part of the tooth; and then we took two controls from the other side and also made a culture from the content of the pulp chamber. Go all through the list and you will have zero practically everywhere, except with formalin concentrated, where we have almost a perfect sterilization of the tooth, and also a high percentage of efficiency

with eucalyptol and phenol compound for five hours and twenty-four hours.

We then undertook to determine the efficiency or the ability of double salts of ammonia and silver to sterilize the tooth. That is the Howe method. It consists of taking a 25 per cent. solution of silver nitrate and adding to it ammonia until a precipitate is formed and then adding just enough more ammonia to re-dissolve the precipitate. That solution is pumped into the tooth and is called solution No. 1. It is followed by solution No. 2, which is a formalin solution. The formalin precipitates the silver in the tooth structure and according to Dr. Howe we should get a very high percentage of efficiency. It has the great disadvantage of discoloring the tooth; it makes the tooth as black as black can be. It is said to be a means of immediate sterilization, for you may use this treatment for five, ten or fifteen minutes and fill your root immediately, no matter how badly your tooth is infected. The efficiency of the teeth treated in that way, was 69 per cent. in the first group of cases, 78 per cent. in the second, 84 per cent. in the third and 95 per cent. in the fourth, and the difference in the four groups was, that an increasingly more perfect technique was developed for making the application. We have then, with that method, a means that is much more efficient for the sterilization of the teeth than our old methods of trying to soak the teeth with medicaments for days and weeks; but as I said it has the very great disadvantage of very seriously discoloring the teeth.

We made determinations or observations with dichloramin-T and chlorozene and had results. With series 1, 2, 3, 4, and 5, with chlorozene cream we had efficiencies up to series 4, of zero, but with four treatments on four successive days with chlorozene four per cent., we got fifty per cent. efficiency. Six treatments on six successive days, changing the medicament every day, gave us 100 per cent. efficiency. With dichloramin-T, we got 100 per cent. efficiency on three different occasions. Then why not use dichloramin-T? We seldom have had presented to us a drug with so splendid possibilities as dichloramin-T, and seldom have we had so great disappointment in that it is so powerful an irritant. I personally have never used a drug that has given my patients so much discomfort as even dilute solutions of dichloramin-T. I would not advise you to put even one per cent. solutions of it in the tooth because of the powerful irritating effect. It is exceedingly painful when used in that way. It may be that we will learn how to use it and modify it so that it will not be so irritating, but I will ask you to be very careful not to use many of the preparations that have been put out and advocated, on the basis of the general efficiency of dichloramin-T. This you know is the chemical that was presented by Dakin, and the basis of the second of the Dakin-Carroll solutions; it is very efficient when used in open wounds in the way indicated, but is extremely painful when used

in the alveolar tissues or placed into the open root apex. We should have hopes that out of this medicament will come a more efficient means of sterilization than many of those we have been using.

Now, there is one other drug I wish to report to you, or rather that I wish to emphasize, which you are already familiar with. We have all learned that formalin is efficient as a sterilizing medium, but that it is very irritating under certain conditions to periapical tissues. It is probable, however, that the reason we have had undesirable effects from the use of formalin compounds, has been because we did not use them in a way that would be compatible with vital tissues. Dr. Cameron working in Philadelphia for sixteen years now has been following out the treatment of Dr. Lane, in care of the boys at Gerrard College. He has some sixteen hundred boys under his care, and his results are superior, so far as I know, to the results of any person in the country in the use of formalin. I have seen the boys, I have gone there to study the results, and he has the wonderful record of having literally hundreds of those teeth in the most putrescent condition, treated for five minutes or ten minutes with not more than a four per cent. solution to start with, and then finishing off with a two per cent. solution of formalin, filling the root immediately after the five, ten or fifteen minute treatment with the two per cent., and having better results, if we can judge from the comfort of the patient, than any of us, so far as I know, have been having with our methods and treating by the day and week. I present that method to you with more confidence than any other method I know of to-day, not even asking you to except the silver formalin as being superior to it. It is free from the discoloration that you get with the silver and formalin — silver nitrate turning the teeth black, and it produces, contrary to perhaps your expectancy, practically no irritation to the tissues, if used in a two per cent. solution in the way indicated. Put your four per cent. solution into the accumulated debris and use it as a solvent for washing out the pulp chamber and canals, but not undertaking to put any of it through or to the apex. Follow that with a two per cent. solution of formalin. Place a hot wire into the two per cent. solution of formalin in the canals, and when the solution is raised in temperature to about 120 degrees, which will not be particularly uncomfortable for the patient, formaldehyde gas is given off rapidly and profusely and passes into the structures of the tooth. He never uses enough to flood the tooth. He carries on a pledget of cotton just a small quantity to moisten the surface of the canal. He follows that with hot air, and the warm air drives the formaldehyde gas into the tooth. Teeth treated in that way show, by his results and experiments, a very high percentage of efficiency, and our tests in the laboratory have confirmed it as more efficient than the methods we

have been using in the past; namely, saturating the tooth with essential oils, etc.

We then ran a series of controls to ascertain whether or not the various drugs themselves were free from bacterial growth. We were surprised to find that nitric acid contained an organism, that phenol two per cent. contained an organism, that hydrochloric acid contained an organism, that sulphuric acid contained an organism and that hydrogen dioxide contained an organism, and when those were put on medicated points, sometimes we got a very definite growth growing out in the culture medium even though we had used sterile culture points. The effect of the point on the medicament was such that we got, in some cases, a growth where we did not get it by putting the medicament or point directly into the medium. We had streptococci, gram, positive and negative organisms, etc., frequently. In other words, many of the medicaments carry organisms. There are organisms that will grow in a 50 per cent. solution of sulphuric acid very luxuriantly. We have supposed it was the *sine qua non* for sterilizing tooth structures. It is not. Fortunately it does kill the streptococcus quite readily, and that is the organism we are most often combating.

Our next series of studies were some that I directed and in which I had, now Lieut. Damolos assist as technician. We got some very interesting results in determining whether or not our root fillings can shut bacteria out of sterile dentin, even if we succeed in sterilizing the tooth. Eleven sterile straight teeth were used, prepared by Dr. D., the root filled by Dr. H., and cultured by Dr. T. These teeth were autoclaved, then the root filling controlled carefully to see whether they were perfectly sterile, and they were sterile. The root filling was placed in the tooth, the crown of the tooth covered with paraffin, and the apex left exposed to the infected culture medium; just as the apex of the tooth in the mouth is exposed to an infected culture medium when we have treated and filled a tooth that has been abscessed or infected. A, which was the root canal filling near the apex, was infected in 30 per cent. of the cases; B, the dentin, in which our efficiency was ten per cent. and infection 90; C, the root canal filling the apical third, 90 per cent. infected, 10 per cent. efficiency; D, root filling middle third, 60 per cent. infected, 40 per cent. efficiency; E, root filling gingival third, 40 per cent. infected and 60 per cent. efficiency. These teeth were left for two weeks in the infected culture medium. We then took six sterile teeth prepared by Dr. D., root filled by Dr. D., and culture prepared by Dr. D.; the root filling was chlorapercha and guttapercha. In A the cementum showed a streptococcus growth in 15 per cent., or 85 per cent. efficiency; in B, the dentin showed streptococcus growth; C, root filling, 40 per cent. growth, 60 per cent. efficiency; D, root filling in middle third, 60 per cent. growth and 40 per cent. efficiency;

E, root filling, gingival third, 80 per cent. growth, 20 per cent. efficiency. That is not very good.

We then ran a series in which we used 20 teeth, and we have the different structures, the gingival third, middle third, apical third, dentin near apex and cementum near apex. These teeth did not have the crown protected with paraffin or any other material, and out of the 20 teeth only four equalled one hundred per cent. efficiency or a net efficiency of 20 per cent. Now, I wish to show you something interesting. You remember the root filling is acting as a cork. In this case the culture could enter from the crown as well as from the apex, and we have the cultures more profuse where the root canal was the largest. In other words, the guttapercha root filling, when it was thoroughly sealed, did not close out the bacteria from the root canal. Our efficiency, as you note, is an average of 20 per cent. That is very low. Chlorapercha was used in all but two in which paraffin was used, and resin and chloroform, which was used in five. The paraffin showed 40 and 20 per cent., the chlorapercha showed 20, 40, 80, 60 and 62, and resin and chloroform showed 40, 20, 20 and 40.

We then took thymocresol and made a series of tests. We found the efficiency in one series zero and in another zero, 50, 20, 20 and 70 per cent. No tooth was free from infection in some part of the tooth, so our net efficiency was zero. These operations were made as carefully as we could in the laboratory.

We then took 17 sterile teeth and took as root filling material chlorapercha and guttapercha. The infection actually went in through the apex of it; it couldn't go in any place else because the entire tooth was covered with paraffin.

Somebody recently said to me, there was a time I could go to my office in the morning and sing all day and when I shut my door at five o'clock in the evening I left all my office cares there and went off as free and light as a bird, but you fellows have taken all the joy out of dentistry. If ignorance is bliss, why, we may have taken some of the joy out of dentistry, but, gentlemen, these are times in which we have something else to do than to be happy and simply exist. It is a great responsibility to live to-day. The man who is going to live and take a place in the world and use up the bread and butter that is so scarce these days must do something worth while for humanity, or else he had better go and ask somebody to bury him.

This question of root filling is an exceedingly complicated one. We are undertaking in the studies we are making at the Institute now to determine not only where the infections exist in the teeth, but determine how we may perfect root filling methods and materials so that we may seal the bacteria out of the tooth structures after we have succeeded in sterilizing, assuming we succeed in that, for I believe we will.

ROOT FILLINGS IN EXTRACTED TEETH BY SELECTED DENTISTS.

Dr. Price then made reference to a series of teeth which had been sent out to be root-filled by a group of selected dentists in different sections of the country, and in referring to the results, said, if that is the average, gentlemen, of the dental profession, we might as well take our hats off to nature and say she has been very tolerant and kind, and we have assumed a whole lot of the credit due to nature, for we did not do what we thought we were doing. If these facts are facts that are borne out in our profession, I myself believe I have never done as good work as the average of these dentists who tried in this experiment to make a root filling as nearly perfect as possible and had every opportunity to do so. In other words, I believe it is almost a physical impossibility, with the materials we have now, to fill a root canal so perfectly that bacteria can't get into it in some way or other some time. What does it mean? Let us try to keep the teeth alive; and the man who, in the light of to-day's information, will deliberately take the pulp from a tooth for the sake of putting on a bridge in a stronger way than he could put it on by leaving the pulp alive, has, to my mind, not fully realized the responsibility that is upon him, to so fill that tooth from which he has removed the pulp that no bacteria can ever enter. It is not a problem, gentlemen, of shutting bacteria out at the time we root-fill; it is a problem of keeping the environment about the apex so nearly normal, that there will be no change in that tissue which will ultimately make it a culture medium for bacteria. I would infinitely rather have you take bacteria from my mouth and inject them into the healthy alveolar bone or gingival tissue, than to put acid through the root apex of that tooth and destroy the tissue, so that it later would become pabulum or culture medium for bacteria. Organisms will find their way through the body and find a culture medium no matter where you hide it, some time; and you do not have as your problem simply keeping bacteria away from the apex of the tooth, but your problem is to keep culture medium away from the end of that tooth.

UNCERTAIN RESULTS IN USE OF GUTTA PERCHA.

With reference to the results of our studies of root filling materials, particularly guttapercha, let me tell you in a word what they were. Guttapercha as it comes to us in cones or blocks, is a great deal like a piece of wax that has been rolled, or rubber that has been stretched and frozen. All you need to do to demonstrate that, is to take a slab of base plate guttapercha and make a drawing around it on a piece of paper as you take it from the box; throw it in hot water for a few minutes, then take it out and lay it on the same area and see how it has changed shape; instead of being five inches long and two and a half inches wide it will have shortened to say four inches long and three inches wide. Why? It has an elasticity in the

state in which it was rolled, it was congealed and held in that position and you have that elastic content locked, and immediately you apply heat it creeps. That can happen to a degree when you put guttapercha into a root canal, and undertake with a warm instrument to make the guttapercha plastic, so that it will flow. That is not our greatest problem, for we do not use heat particularly to make guttapercha flow, we use a solvent like chloroform. When guttapercha is dissolved in chloroform and allowed to re-congeal to the point at which it is just dense enough so that you can make a dent in it with an instrument, it will have about the density that it would have when you can work it in the canal of the tooth. Probably most of us will use more pressure after it is sealed hard, and the chloroform has evaporated, than in that state I have just explained. Before I tell you the ratio of the dimension with that much chloroform in, namely, the amount that will make it possible to make it flow after all the chloroform is gone, I am going to ask you to do a little guessing. What is your impression as to the relative volume of the guttapercha, when it has only enough chloroform in it to make it flow? As 260 is to 100 (2 6-10ths, in other words), that is when all the chloroform has gone out. Those are not my figures alone; they are made by a splendid physicist, Professor Daton C. Miller. When we use a solvent with our guttapercha to make it flow, we have a mixture that occupies more space than the root filling will have, when all the chloroform is gone out. We may take that up by adding enough more guttapercha to take up that chloroform, and a number of other expedients, suction, pressure, etc., but I know of no way whereby guttapercha can be manipulated in the root of a tooth so that there will not be considerable contraction, which largely accounts for the errors which are shown in the results I have given you to-night.

DISTRIBUTION AND KIND OF BACTERIA PRESENT.

Now, we will study the distribution and kind of bacteria that are present, and I show you a number of teeth, using the Alport system to indicate the point in the tooth from which the culture was taken, the organism found, and in the roentgenograms you see the amount of destruction shown in that tissue. We have, first, a patient with acute rheumatism, next a patient with chronic rheumatism, and third, a patient with heart infection. In all these cases we have gotten a mixed culture, but when we inject into animals the organism that has grown-out, is and always has been a streptococcus, and rarely have we found anything else growing in the tissues of the animal except streptococcus.

If I had time to go into a discussion of the physical characteristics, or I might say, the distinguishing characteristics, of different lesions, and focal infections of the mouth, I would emphasize as the most important, that the tooth that is likely to be producing and contribut-

ing to acute rheumatism, chronic rheumatism, heart irritation or neuritis is likely to be a tooth without a fistula. I will express that in another way. That in a large number of tooth cultures from a number of patients, less than five per cent. of the teeth had fistula in those very extensive periapical infections, where the patients had those lesions that I have named. Again, the teeth that are most likely to be producing neuritis and acute rheumatism, may have not only a very little lessened density of bone, but may have an increased density of the bone a condensing osteitis.

I am particularly glad to have Dr. Harold Box here to criticize this, because I consider him one of our very best tissue pathologists. It is a significant fact that in 30 patients we treated at the Institute this last year, under exacting conditions, which had an acute rheumatism or chronic rheumatism, and particularly neuritis, that seemed to be related to dental infection, in a large number of instances we had to cut the bone away from around the teeth before we could extract them? You have seen it in your practice if you have been watching for it. It seems to be true that there is a change taking place in the supporting tissues of the tooth caused by the presence of the organism and which is not one of rarefying osteitis which so many are looking for as the means by which we will make a diagnosis. Personally I have come to be as much or more concerned for the teeth with an increased density as those with a marked rarefaction, particularly when the patient is showing a marked chronic manifestation.

HEREDITARY INFLUENCES.

I want you to consider now some information from an entirely different angle, for we are going to study the other side of this equation. We have been studying the tooth and its organisms. We want now to study the patient and her resistance. Insurance companies are always looking for new methods by which they can determine a man's danger of infection, and they have brought this remarkable information that the patients that have neuralgia, headache and nervousness, colds, abscesses and skin troubles are found in these percentages, 31, 19, 22, when the patients are without devital pulps from crowned teeth. You notice those percentages are small. They have found in patients with devital teeth that the percentage has increased: 10, 50, 117, 15, 68, 53. But when this lesion has gone to the extent, in patients with devital teeth, of blind abscesses and definite areas of rarefaction you must increase the percentage to 18, 64 and 164 per cent. When the heads of the Metropolitan Life Insurance Company had that information furnished to them by Dr. Hyatt, the head of the Dental Department, they said that is one of the most important contributions that has come to us in a long, long time; and when the statistician found it he said, a matter of three or four per cent. we consider a big thing, and 10 or 20 per cent.

is very significant, but when you bring us figures up to 164 per cent. it is overwhelming, it means it is something we have got to give attention to, and our whole Department must adapt itself to it. The result is that that splendid Institution is suddenly diverting its activities right there to see what further information they can get. This comes from an external source entirely, the statistics of men who are in the life insurance business.

Now, another group of men have been at work and they are the men who have been getting statistics to see what part heredity plays in the development of disease, and they have been concerned, particularly with mental conditions, with idiocy, and the Mongolian type and the various lesions that would be expressed in the tendency to criminality, etc. They bring us the information incidentally often brought out in their charts, that heart disease seems to be inherited in some way. They have not been trained at all as physiologists or pathologists, they are simply statisticians; they have unearthed that important information, and I want you as a jury to sit in judgment on that evidence and see whether it is worth anything. They were not prejudiced; they were not looking for the information, it simply came out incidentally in connection with their other work.

The next is a study of chorea patients and the results obtained in studying nervous troubles. They have not even probably thought of the pathology underlying it, they are simply stating a fact to you. Then we have digestive troubles that seem to have been inherited. A man had a lesion, his son had a lesion, his daughter did not, but she married a man who had a lesion, and two of their offspring had the lesion.

When a trait is inherited by an individual something material has been transmitted, and if you will think of the germ cell as a train of cars and express cars, if you please, and each car loaded with packages about as big as your hand, and every one of those express cars filled right up to the roof, you will have an idea of the number of determiners that are carried over in each of the male and female sex cells. If now you will take that train and divide it from one end to the other through the middle, take half of every package and put it in one lot and take half of the other package and put it in another lot, and then split another train right through the middle and take half of each of the packages contained in that train and put it with the opened half package of one of this other train, and finally make up a new train, half of each train made from half of the original train, you will see what has taken place when the two germ cells get together. Each one of those packages we will call a determiner of a character. Now, have this in mind for a moment, there are three great fundamental principles of heredity and only three. You can get it all in these three great laws of heredity. I don't think you will find it difficult to grasp. First, that the characters or characteristics

of the human body, whether the color of the eye or skin or resistance to disease—*characters are inherited as units*. That means that the color of the hair will be inherited independent of the length of the nose or the height of the stature. Each character is a unit and independent of every other unit. Second, *characters are not inherited at all but the determiners for those characters are inherited*. My boy does not have my nose, because I still have my nose, but my boy has a nose like mine; he has the determiner for a nose like mine. The character was determined by the determiner that gave size and shape to the nose. And, third, and this is the hardest one of all, that *my boy does not inherit anything from me that I did not inherit from my ancestry*; that my boy and I are half brothers by different mothers. That is a hard thing to accept, but it is just as true as that we are sitting here. I cannot transmit anything to my boy that is not transmitted to me. I can at best pass on to him a series of determiners just as good as I got them if I am very careful of them. I may probably, and that represents the progress of the race, be able to improve them an infinitesimally small amount by giving them an ideal environment and my boy is a half brother of mine for he has received a determiner for a nose like that from the same origin I got that determiner and that my father got that determiner; and those determiners are transmitted down through from one generation to the other, and are resident in the sex cells only of both sexes, and have nothing to do with the hands, arms, feet and brain, and the rest of the body. They can be destroyed in an instant, certainly in a few minutes, by certain chemicals, particularly alcohol, lead and arsenic.

Dr. Price then gave further illustrations bearing upon the question of the determination of characters or characteristics through or by means of the sex cells.

HEREDITARY INFLUENCES APPLIED TO PRACTICE OF DENTISTRY.

Now we come to another phase of it which is the reason for the previous discussion, and I want you to take this with a great deal of care and be very critical. So far as I know it is a new interpretation, is not worthy of being classed as a demonstrated fact. It is suggested to you for study and I want you to be on guard and not allow yourself to be influenced by anything I may say, for it may not be based on facts. When I presented this in one of our leading educational centres recently to a mixed dental and medical audience in which some of the greatest pathologists of this continent were present, one of them said in discussion, "All I can say is, it is delightful but doubtful"; and another in discussing it said, "To me, in the light of our teaching, it is heretical." I have had the satisfaction of having one of those men state to me since in a letter that some of the evidence I presented seemed to be borne out by further observations. I want to say to you as we have gone on with these studies they are getting more and

more delightful and less and less doubtful, which is an encouraging feature.

The thing I want you to think of is this, that you and I have inherited a resistance to disease that may determine whether or not it is safe for an infected tooth to be left in our body; and it is more a problem of our resistance than it is a problem of the infection of a tooth; that focal infection in the mouth is rarely, if ever, the primary lesion in the case of rheumatism and neuritis, though it is often the secondary one. You and I have a definite resistance to typhoid depending upon whether or not we have had typhoid. If we have had typhoid we are not likely to have it again. The very fact that we have had typhoid is our protection against typhoid, Why? Because by having it we have built up a chemistry that combats that disease. Some of us will not have tuberculosis because we have a normal resistance to that organism. We probably have inherited a high resistance to it. The question as to whether or not we will have tuberculosis is one of our resistance and the largeness of the dose that we must get to break our resistance will depend upon not only our inherited and acquired resistance, but also upon the amount of depression that is put upon our body to destroy our normal resistance to that disease. Again, our resistance is in proportion to our age pretty much, and as we get older we will have less and less resistance, and the time will come when probably the majority of the men in this room will die as the result of a type of infection that is in their mouth or body at this very time, and the time at which it will come depends upon when that organism is present in the body in large enough quantity to overwhelm the body or when the body has its total resistance lowered to a sufficient point. One of the greatest pathologists of this country has made the statement that 90 per cent. of the people living to-day in our civilized communities will die as the result of an infection of the streptococcus variety. That the streptococcus will strike the final blow. The other ten per cent. that do not die of that will be people that will be killed by accident. What does that mean? A man gets pneumonia and the thing that strikes the final blow in pneumonia is very often, if not generally, a streptococcus infection that gets into the circulation, and the pneumonia lowers his resistance down so low that finally the streptococcus which is growing in his body gets into the blood stream and suddenly his resistance is so low that it can develop there. A large number, as you know, of the so-called diseases of to-day are not diseases at all, they are simply symptoms of disease. The disease is the lowered resistance to systemic infection, and the thing that we have called cholecystitis or nephritis is simply a symptom of this general condition. How many men in this room had growing pains when you were a little boy? The men that have not had it don't know what you are talking about. Will you men who have had growing pains tell me whether you have had trouble with your tonsils?

The thing I want to bring to your attention is that there are certain susceptibilities that are liable to relate themselves together. You men who had growing pains when you were children, if you had the real thing, had inflammatory rheumatism. You have in other words inherited very probably a susceptibility to rheumatic infections. Did any of your family have rheumatism?

DR. WALDRON: My father had it before he died.

DR. PRICE: I am very glad he didn't have it after. Do you see what I am getting at. Determiners are handed down from one generation to another that furnish the resistance to the streptococcus infection and to pneumonia, typhoid and tuberculosis, just as there is a determiner to the length of the nose and the color of the hair. Do you see the point? There are a whole lot of people that will have an unequal fight in life if they have a large amount of infection in their mouth; and I think I can show you people that can stand a thousand times as much infection as some others can stand, because they have so high a normal resistance to streptococcus infections. When a little child is born the alimentary tract is free from bacterial growth. Within twelve hours the streptococcus appears and that organism is never absent from the human body and from the alimentary canal from that time until death, and it lives as one of the complements of life in the body that has a high resistance; but in a body with low resistance, if it can grow in a culture medium that is suitable to make it develop its affinities for tissues, it will take on a quality that will make it attack certain tissues or liable to attack certain tissues of that body. The primary lesion is the human body's lesion in that it has the lowered resistance and when you men take a roentgenogram to any of your fellow practitioners and ask him to read it and you say, tell me what I should do for that patient? Remember he ought to study that patient for an hour or two hours before he can answer your question. The information is not in the roentgenogram in the first place, for 25 per cent. of the teeth we found seriously contributing to infection in our work in the institution did not show the lesion in the roentgenogram.

The method I suggest for approaching this subject is by a study of the question of inheritance susceptibility (as shown by chart). If there is any false philosophy or false pathology or false biology included in this I want to know about it.

Dr. Price then gave a number of slides illustrative of various groups of infection, together with charts taken from practice showing the influence of acquired and hereditary susceptibility and immunity.

In reference to rheumatic affections Dr. Price stated that while he might be entirely mistaken in it, it seemed to be true that patients who have susceptibility to true rheumatism do not have susceptibility to true neuritis; that very rarely were they both found in the same patient.

In conclusion Dr. Price stated that what he had shown would be

sufficient to convey the thought, namely, that the resistance of the tissues is the primary and most important factor, and that resistance is a quality that is determined partly by inheritance and partly by environment, and that we can acquire a susceptibility and we can inherit a susceptibility.

In reply to an enquiry from Dr. Webster whether we are justified in denominating a lowered resistance as a lesion, Dr. Price said, justification for that is not based necessarily on the definition, as we ordinarily understand it, of lesion, but on a liberal construction which would make us see resistance as a normal part of the mechanism by which the body fights disease, and any interruption or any factor that is taken out of that mechanism I would say was a lesion. There is a factor lacking in the body that has a lowered resistance, and that element that is lacking I am speaking of as a lesion—a lesion in the mechanism. I may not be justified, but that is the way I consider it.

STERILIZATION OF CUTTING INSTRUMENTS.—Knives can be safely sterilized by chemical and mechanical means without the use of heat in any form. Immersion in 95 per cent. alcohol has the *least*, and boiling the *most*, effect in dulling the edge of a knife.

FINISHING OCCLUSAL SURFACES.—To polish deep grooves in inlays, cast crowns, or dummies, employ dull fissure or round burs in the engine, after which a beautiful finish may be secured by polishing with a small brush wheel, charged with polishing material.—N. R. Smeltzer, Dental Review.

USE OF TOOTHPICKS.—There has been a good deal said about toothpicks, pro and con, one person advocating a quill and condemning a wooden toothpick, and his next door neighbor holding just the opposite view. If food has jammed between the teeth, I would advocate the quickest means of getting it out, whether with silk floss or toothpicks, using care not to injure the gums, for it is commonly believed that a great deal of infection takes place through these little abraded surfaces. In fact I think rubbing the tooth surface and gently massaging the gums with a wooden pick is productive of good results, for it stimulates the circulation and breaks up and removes microbic plaques and other debris. The pernicious habit of systematically jamming a toothpick into interproximal spaces, crowding the gum tissue down and then giving the pick a twist, thereby lacerating and cutting the gums, should always be watched for and stopped, for the little pockets formed by the recession of the gums from this cause are places where debris lodges, and they make an ideal incubator for growing bacteria, thus infecting the gums and producing inflammation, which causes serumal deposits to gather and pyorrhea will follow.—F. H. Skinner, Dental Summary.