OBSCURE SYSTEMIC EXPRESSIONS OF DENTAL INFECTIONS

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by

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To my professional brothers in Australia, I wish to extend very earnest greetings. While separated far by land and sea, we have a very common ground in our mutual interest in humanity's welfare, and a common responsibility as members of the dental profession in directing thought and practice with regard to the inter-relations of dental conditions to health.

I have chosen as a subject, - Obscure Systemic Expressions of Dental Infections, - both because of the importance of our newer data, and because I consider it the weakest point in our present system of care of humanity as a dental profession.

Individuals are considered well, except in those particulars in which they or their dental or medical diagnostician recognize a disturbance or divergence from normal. If they are affected by a painful disturbance, they know of the lesion, and can report it, and if there is physical change we may recognize it. Neither the operator nor the patient however, will recognize such lesions as may be obscure and beyond the boundary of their vision. Metabolism disturbances may be present in severe form and the patient consider himself to be entirely well. I

thought, therefore, it would be of interest to review some of the evidence both from the work of others, and that which is being carried forward under my direction. First, with regard to results obtained by workers who approach the problem from both the laboratory and clinical standpoints as exposed in other branches of the healing sciences:

Pemberton, and Peirce, working in the Presbyterian Hospital, at Philadelphia, have reported in the American Journal of the Medical Sciences, for January 1927, important data which relate to our problem. This paper is entitled AClinical and Statistical Study of Chronic Arthritis Based on Eleven Hundred Cases. It is of particular interest that analysis of 945 cases with regard to focal infection reveals in 163 civilian men, foci in 77 per cent, of which tonsils furnished 36 per cent, dental conditions 57 per cent, combined dental and tonsillar, 12 per cent, combinations of foci other than dental or tonsillar 25 per cent. In 382 civilian women they found foci in 67 per cent of which tonsils were 29 per cent, dental 53 per cent, combined dental and tonsillar 13 per cent. In an army group of 400, they found foci in 75 per cent, of which 52 per cent were tonsils, 33 per cent dental, and 19 per cent, combined dental and tonsillar. The numerical ratio of various kinds of foci to the total number of foci found show in civilian men: tonsillar foci 46 per cent, dental foci 74 per cent; in civilian women, tonsillar foci 43 per cent, dental foci 78 per cent; in army men, tonsillar foci 71 per cent, dental foci 46 per cent. They say in their summary regarding their studies:

"It emphasizes the importance of instituting vigorous

treatment and justifies sustained and intensive effort. The impression still prevails in many quarters that arthritis is an incurable disease, whereas, in fact, there are few disease-states for which more can be done."

They bring out another point of very great interest. In my paper before the American Medical Association in June 1924, published in the Journal of the American Medical Association, January 24, 1925, entitled, Dental Infections and Related Degenerative Diseases, and in my two volume work on dental infections, Volume I, entitled, Dental Infections, Oral and Systemic, and Volume II, entitled, Dental Infections, and the Degenerative Diseases (1) I presented data indicating that involved in the type of expression of disease state, there are individual characteristics with regard to the way in which calcium is metabolised and the nature of the structural changes which take place in calcified structures. These data indicate, for example, that the individuals who are susceptible to arthritis , particularly the proliferative type, tend to calcify the tubercles, or at least, individuals with tuberculosis of the miliary type do not as a group tend to develop arthritic lesions. My observations include studies of groups of individuals in civilian life, and in sanitaria, including a trip to Saranac Lake, for preliminary survey. With regard to this point, Drs. Pemberton and Peirce summarise the data brought out in their general discussion asfollows:

(1) Vol. II. Chapter LXI, page 118. Dental Infections and Tuberculosis.

"Active tuberculosis was very infrequent. This conforms to the experience of Dr. Lawrason Brown, of Saranac Lake, who found only 11 cases of positive rheumatoid involvement among 4499 cases of tuberculosis."

My researches on calcium metabolism have gone much farther in this direction and quite completely confirm these findings, and throw much additional explanatory light on the processes.

Additional contributions to the general problem of the nature and influence of focal infections are comgin from many sources. At the recent meeting of the American Medical Association in Washington in May, in the symposium on heart involvement, it was very significant that much emphasis was placed upon the fact that one-fifth of all deaths in our modern civilized communities are from heart involvement and further, that in comparing two groups of children, one of fifty thousand children from whom tonsils had been removed in the city of Rochester, New York, and the normal controls, the incidence of subsequent heart involvement was much less in the group that had had tonsils removed. Much influence was placed upon the influence of acute rheumatic infection upon the incidence of heart involvement. Clinical reports of internists of this country are more and more stressing the important relationship between the early heart involvements of childhood and the recurring severe heart involvements of adult life. One of the very important recent contributions to this general subject is that of James Craig Small of Philadelphia, published in the American Journal of the Medical Sciences, for January 1927, on "The Bacterium Causing Rheumatic Fever and a Preliminary Account of the Therapeutic Action of Its Specific Antiserum". In this contribution he has demonstrated, not only the very familiar

lesions in animals produced by the inoculations of cultures from focal infections, teeth and tonsil, of involved patients, but he has also shown that a particular strain that he has used has produced an antiserum, first in a rabbit then in a horse which when injected into a patient suffering from acute rheumatism, and heart involvement had produced very beneficial effect. This seems to constitute a great step in advance both in etiology and treatment. It emphasizes however, the importance of focal infections as harboring places for strains of streptococci with specific localization qualities. Indeed Dr. Small has chosen to name the organism which he has isolated, - Streptococcus Cardioarthritidis.

When we view this information in the light of clinical findings, We have such data as that furnished by Ely working in Stanford University, who reports the arthritic affections of the proliferative type constitute one-tenth of the clinical conditions seen in that clinic. Willcox and Beddard of England have placed the incidence of dental infections as cause of arthritis very high as follows:

> "Ninety per cent of the cases of non-specific infective arthritis are due to infections arising from the teeth."

The incidence of arthritis as a lesion in the clinics of Cleveland has so greatly reduced that two internists of large experience have recently reported to me that whereas they used to see both in private practice and in the clinics large numbers of cases, the condition is becoming relatively rare, and both expressed the conviction that its reduction has been largely due to the changed policy regarding the course that shall be taken in the management of infected pulpless

teeth. In other words, since extraction of infected pulpless teeth has been practiced by a large percentage of the profession here, arthritis has been greatly reduced as a community affection. The problem is in general reduced to the following factors: What constitutes an adequate factor of safety in dealing with focal infections, and what means are competent to adequately eliminate dental infections when such exist? This latter is an extremely difficult problem and can scarcely be considered apart from the first of these two propositions, since undoubtedly there is great difference in individuals with regard to what constitutes an adequate factor of safety.

With the advent of the development of x-ray technique, great assistance has come to the profession in diagnosing important structural changes. All too frequently, however, individuals are diagnosed as though all people behaved and reacted alike, and therefore were comparable. We have assumed that the filling-in of bone where there has been a zone of radiolucency, was adequate proof of its sterility. Figure 1 shows two views of a tooth taken a year apart which tooth has had no treatment to which to give credit for the apparent reduction in the zone of radiolucency about the apex. During this year, this patient has been ill. The tooth has not given trouble. Indeed, the patient was not so conscious of it during the period of her sickness as previously.

I have presented much evidence in other communications, indicating that individuals can be divided into groups on the basis of the type of reaction that occurs in bone about infected teeth. During the several years in which I have been carrying on these intensive researches, which are being pushed forward with unabated energy,

I have not been able to find a method, whether of my own, or that of another person, that was competent to make it possible to sterilize infected cementum at the root apex, by treating through the pulp chamber and dentin. This has seemed so important a problem that I have offered a prize of $500 to any one who can present a method competent to do this.

Several workers have indicated that different strains of streptococci may be present in a single tooth. H. Warren Crowe of Harrogate England has presented a method of culturing by which he has been able to demonstrate the presence of as high as twelve different distinct strains in a single tooth. Using Crowe's technique, corroborating evidence is being produced in my laboratory at this time. The question as to what constitutes, therefore, a safe tooth, is not answered by a patient's negative x-ray picture, which shows what we may interpret for lack of exact information as a relatively normal periapical condition.

A very earnest worker who has had an unusually good clinic from which to obtain material is Dr. Russell L. Haden, working in the Deaner Institute of Kansas City, and in the hospital of the University of Kansas City. He has published many papers, among which a very important one is entitled, "Lesions in Rabbits Following the Intravenous Injection of Bacteria from Chronic Periapical Dental Infection", appearing in the December, 1926, number of the American Journal of the Medical Sciences. In this article he reviews a number of his findings which should be of great interest to the members of the dental profession. In general, his work has corroborated in a remarkable way the findings of Rosenow, and myself, and others, with regard to elective localization qualities or organisms obtained from dental infec-

tions. We are particularly concerned in this discussion with his findings with regard to the roentgenographically negative teeth as compared with roentgenographically positive teeth. He shows results from inoculations of 232 animals with cultures from the teeth of 89 patients in which the roentgenographic evidence was negative, and the percentage of animals showing lesions was as follows: Joint, 59; Kidney, 36; Muscle, 24; Endocardium, 17; Myocardium, 9; Brain, 3; Eye, 13; Stomach and duodenum, 7. It is quite important to note that the number of patients in this experiment where the roentgenographic evidence was positive was 93 and the number of animals inoculated 224. The localizations were in this group in percentages: Joint, 63; Kidney, 34; Muscle, 22; Endocardium, 16; Myocardium, 12; Brain, 5; Eye, 13; Stomach and duodenum, 16. In other words, he found roentgenographic negative teeth to furnish approximately the same percentages of localizations as in the positive. This is again quite in accord with the results that I have published and with the results as published by Dr. Rosenow. His table of elective localization of bacteria from dental foci of infection, is particularly important to the members of the dental profession. As the result of inoculations of 1500 animals with the cultures from 501 patients, he found that in those cases, where the individuals were suffering from a known lesion in a particular organ, or tissue, there was a marked tendency to localization in that organ or tissue of the animal. For example, in cases where the patient suffered from kidney infection, 85 per cent of the rabbits developed kidney infection, as compared with 28 per cent in patients with no known lesion. For endocardium, the figures are 57, as compared with 17; myocardium, 37 as compared with 9; eye 65 as compared

with 9; stomach and duodenum, 57 as compared with 13.

My researches of late have been concentrated on the relation of dental infections to blood stream changes, with special consideration of calcium metabolism, and changes in hard and soft structures of the body, and the relationships to disease states. The brevity of this paper will permit of but two or three illustrations. The title of the paper limits the discussion to obscure systemic expressions. I cannot, therefore, discuss the very large group of affections, whose clinical expressions are so marked as to make them easily discernible, such for example, as myositis, arthritis, iritis, cardiac lesions, neuritis, etc.. I will be glad to send reprints of papers dealing with this phase, so long as they are available.

Chronic dental infections frequently have no other expression as discernible to the patient than the production of lassitude. A microscopic study of the blood in these cases will generally show a change in percentage of various types of white blood cells, particularly a depression of the polymorphonuclears, and an increase of the small lymphocytes. A group of such cases is shown in Figure 2. A few workers have put considerable stress upon the appearance of a special type of cell which has been interpreted to be pathognomonic of dental infections. It is necessary to count a very large number of fields, if dependable data are to be obtained. This is an important drawback, and I do not consider it so important as the percentage, above referred to, of the ratio of polymorphonuclears and small lymphocytes.

The dental professionis, or should be deeply concerned regarding primary and secondary anemias in connection with dental infections.

There are two organisms with which we are particularly concerned,- streptococci, and Monilia Psilosis. The latter is a pathogenic yeast, and is found chiefly in hot countries. Figure 3 shows a graph of blood changes produced in a rabbit by cultures from the mouth of a patient with pernicious anemia. A streptococcus was used. It will be noted that not only was there a marked reduction in the red cells, and in the hemoglobin, but a marked rise in color index, with a very marked disturbance of calcium levels, about the time of the appearance of the nucleated red cells, and a very marked reduction in total calcium. The marked aniscocytosis and poikilocytosis of the rabbit's blood are shown in Figure 4. While it is my belief that dental infections can be an important contributing factor in pernicious anemia, I am also strongly of the opinion that the systemic states tend to develop in organisms specific qualities which give them elective localization qualities in tissues affected by the patient. In which case, they become part of a vicious cycle.

Evidence is accumulating indicating that the pathogenic yeast, Monilia Psilosis, may be an important factor in the development of sprue and some forms of anemia, and that it has one of its habitats in the oral cavity, perhaps its chief one in pyorrhea pockets. Ashford (2) working in Porto Rico, reports finding this yeast organism to be present in a very large percentage of the cases of sprue which is very prevalent there. Grove, Vines, Shelton and others, not only found the blood calcium lowered in sprue but have been successful in treating that affection by the use of parathyroid and calcium lactate. Wood (3) has stressed the probable relationship between sprue and per-

nicious anemia, since he has found the Monilia Psilosis in gingival infections, and feces in large numbers in both groups. We have not been able to find this organism in the mouths of normal individuals in Cleveland.

Strains of Monilia Psilosis, obtained from pyorrhea pockets and from feces of patients suffering from pernicious anemia and sprue have been run in rabbits divided into three groups. Group "A" has received cultures of the organism by stomach tube directly into the stomach. Group "B" has received the exotoxin as a bacteria-free ultrafiltrate, obtained by use of a celloidin sack and 160 mm. mercury pressure. Group "C" received an endotoxin secured by separating the organisms by centrifuging and washing in several changes of normal salt solution. The organisms were then ground with sand in a tumbler for several hours and the material separated. One of the characteristic reactions in group "A" (which group received the organisms by stomach tube) has been an increase in a weeks time of total calcium of the blood of 20 to 30 per cent, without a corresponding increase in inorganic phosphorus. The diffusible calcium has increased to about the same extent. Some strains have proven to be much more toxic than others as several of the rabbits have died within a few days after beginning the treatment. There is, however, a marked difference in the virulence of the different strains. Polychromatophilia, anisocytosis, and poikilocytosis have been found in a number of these rabbits, as have also nucleated red cells. The rabbits of group "B" receiving the exotoxin injected directly intravenously have most of them died within a few days time, especially with the exotoxin from certain of these strains. Most of them have died before extreme blood changes have developed, though several have developed quite striking changes such as reduction of erythrocytes, in-

crease of color index, nucleated reds, polychromatophilia, aniscocytosis and poikilocytosis. The toxicity of the endotoxin used in group "C" has been markedly less than that of the exotoxin. Some changes in blood morphology have developed in this group, and an important characteristic has appeared in the blood chemical studies as a reduction in total calcium. In one of these rabbits about 30 per cent of the red cells contained bodies resembling the malaria plasmodium. Figure 5 shows two specimens of blood, one taken from a patient with pernicious anemia in an advanced stage, and the other from a rabbit which received the bacterial product of the culture taken from the pyorrhea pockets of a pernicious anemia patient. The patient's case of several years standing, has been developing for about as many months as the rabbit's has days. They cannot, therefore, be considered comparable in history. It is of importance, however, that many points of similarity are evident. This patient with a venous erythrocyte count of 1,439,000 and 29 nucleated red cells in counting 235 leucocytes, has a total calcium of 8.9, diffusible calcium of 5.4, non-diffusible or colloidal of 3.3, which constitutes so serious a hypocalcemia as to greatly disturb all organ and tissue function of the body. Other characteristics of this patient's blood were marked polychromatophilia, poikilocytosis and aniscocytosis. His hemoglobin was 30 (by Dare), leucocytes 5800, Arneth index 52, polymorphonuclears 44.7 small lymphocytes 52.3, large lymphocytes 2.9, transitionals 2.9, basophilic cells 1.2, with no eosinophils. I will presently present data indicating that one of the body's early reactions in the presence of infections which disturb calcium levels is to increase the total calcium as a means of holding up certain depressing calcium factors. The accumulating data bearing on the relation of monilia psilosis to pernicious

anemia, strongly suggest that calcium disturbances are not only one of the important changes involved but that they directly contribute to several of the blood changes such as the production of leukopenia. Owing to the extreme toxicity of the bacteria-free exotoxin, it has been necessary to reduce the quantity of intravenous injection, since many of the rabbits died within a few days with characteristic central nervous system disturbances which drew the head backward and those that were observed while dying suffered violent clonic contractions with indications of marked disturbances in brain and cord. These tissues are being run for pathological changes. Reese and Beigler (4) recently reported a series of pernicious anemia cases in whih the major symptoms appeared as brain and cord lesions and they have stressed the importance of lesions of the nervous system as being usual involvements. Whether it shall be demonstrated that pyorrhea infections constitute an important etiological factor in pernicious anemia, the evidence compels very serious consideration, and necessitates a program of exacting treatment and prevention, if pyorrhea is not to be a common contributing factor in the various primary and secondary anemias.

Space will permit of only one further illustration of obscure systemic affection, which seems to be related directly or indirectly to dental infections. It is not clear yet as to what extent the patient's affection, namely, diabetes, has been caused by dental infections, and to what extent the fact that the patient has diabetes has influenced the organisms so that they have taken on specific qualities such that they have produced this disturbance in experimental animals. Figure 6 shows the blood chemical studies of a patient with severe diabetes such that she was taking insulin three times a day.

With the removal of dental infections there was not only a marked improvement in her general physical condition but it was evidenced in the blood stream as will be noted by the reduction of blood sugar from 208 to 153. The ability of organisms from a case of diabetes to produce severe disturbance of blood sugar levels in animals is illustrated in the following: The patient's blood sugar was at 245 one hour after eating, and at 216, fourteen hours after eating. The qualities which obtained in the organisms were studied by the following procedures, the planting of teeth beneath the skins of rabbits; the use of a bacterial suspension of organisms grown from the teeth; an ectoantigen, bacteria-free, obtained from organisms obtained from the teeth, the use of filtrate controlled by the use of the same material without its contact with organisms. Of the rabbits with teeth implanted, one started with a blood sugar of 105 and went to 192. Another rabbit with a tooth implanted had blood sugar start at 101, went to 154, and then reduced again to normal, the toothbeing exfoliated. The rabbit receiving bacteria grown from the teeth had its blood sugar go up from 97, to 348 when it died.

One of the most common, and at the same time serious disturbances produced by chronic dental infections, has to do with calcium, and phosphorus levels of the blood. The product of total serum calcium, and inorganic phosphorus of the blood should be 40 or above; if it is less than 40, the individual is in negative calcium balance. This not only interferes with all organ and tissue functions, particularly of the nervous system reactions, but creates changes in the hard structures of the body and in the available calcium reserve of the system which become a distinct menace, in combatting acquired infections.

Such individuals readily develop colds, or in case of illness of any type, make a defensive reaction to that infection much below their normal. About the only symptom the individual would recognise directly would be lassitude. A typical illustration would be the following case, shown in Figure 7. The roentgenograms of the teeth show extensive alveolar change about the infected teeth. With elimination of dental infection, partly by extraction, and partly by treatment, the inorganic phosphorus increased from 3.5 to 4.1; the non-protein nitrogen reduced from 40 to 30; total serum calcium increased from 9.7 to 11.0; and calcium balance changed from negative to positive. The red blood cells increased from 4,900,000 to 5,520,000; the leucocytes reduced from 10,400 to 7,800. Accompanying this was a complete change of mental attitude and general health. All this occurred in about four weeks, apparently as a result of the removal of the dental infection. If we judge patients' relative or actual safety on the basis of the accumulated insults to particular organs or tissues, due to changes in metabolic processes, we are often arriving too late to prevent the grave disturbances. We must look upon many of the phases of disfunction due to structural change in the organ as being evidence that some systemic disturbance has been in existence, usually for a considerable length of time, and that the organ change is a symptom of that metabolic disturbance, and therefore, a symptom of the related disease, rather than being the seat of the principal lesion. It is for this reason that many cases of arthritis remain quiescent and are apparently cured by the removal of dental infections.

Probably no organ suffers more frequently or more severely than the heart in chronic dental infections, yet even heart lesions, when

they are related to dental infections, often show evidence of being an expression of metabolic processes, particularly of calcium, as the result of toxic material from the infection, rather than from direct bacterial invasion.

The dental profession needs to concern itself much more than it does relative to obscure dental infections. It is very significant that approximately 20 per cent of the teeth which we find to have either completely non-vital or badly infected, partially vital pulps are not detectable by the roentgen ray, which suggests that probably one-fifth of the teeth which may be the cause of systemic disturbance are not found by those members of the profession, using the roentgenograms as their chief method of diagnosis. It is particularly unfortunate that the individuals in whom such teeth are likely to be missed are usually the ones that most need to have them found, because they are physically breaking. The reason they are not found is chiefly because there is not an adequate defensive reaction, either to make a structural change which will be visible roentgenographically or to act as a quarantine to defend the individual from the effects of infection. We are, however, confronted not only by this important embarrassment that an individual may harbor serious dental infection and not have it visible due to absence of structural change, but in addition have the great embarrassment that a zone of dense bone as the result of condensing osteitis may surround a zone of rarefaction, and hide it from view. The roentgen rays record the total obstruction in the paths being compared. That conditions may be very different from what they appear to be is well demonstrated in Figure 8 in which are shown two molars, the first of which shows evidence of periapical obstruction, the second molar but little as evidenced by the roentgenogram.

When these teeth were extracted however, it was found that the second molar had as large granulomata on its two roots as had the first molar. This limitation of the roentgen ray is an extremely important matter in humanity's behalf. The reason for conditions being so deceptive is well illustrated in Figure 9. In A will be seen the roentgenographic appearance of a piece of metal $\frac{1}{2}$ x $\frac{1}{4}$ X $\frac{1}{32}$ inch in length. A piece of bone was sawed apart, and this piece of metal placed between and the two pieces brought into position in a vise by condensing the bone laterally where it came in contact with the bar. This chamber is larger than an entire root of a tooth. B. shows the two pieces, photographed toward the depressions. C shows the roentgenographic appearance of the chamber viewed on end, D at 10° rotation, E at 20°, F at 30°, G at 60°, and H at 90°. It will be noted that at 90° the position of the chamber is entirely lost and at 60° almost completely. I shows the roentgenographic appearance of the two pieces, at right angles to the chamber. In the side with the smooth surface, there is no evidence of the chamber. In the side with the tooth, the movement of the material is visible. In Figure 10, a square-ended punch is used and it demonstrates as well as explains the reason for this seeming anomaly. I have discussed these conditions at length in a paper entitled, "Fundamentals Suggested by Recent Researches for Diagnosis, Prognosis, and Treatment of Dental Focal Infections", (Journal of the American Dental Association, for June 1925.) I have also discussed the calcium metabolism problems in detail in the following papers:

The Relation of Light to Life and Health, from the Journal of Industrial and Engineering Chemistry, Vol. 18, No. 7, July 1926

Newer Knowledge of Calcium Metabolism in Health and Disease, with

special consideration of calcification and Decalcification Processes, Including Focal Infection Phenomena, from the Journal of the American Dental Association, December 1926.

Calcium Metabolism Studies. A. The Raising of Serum Calcium by Topical Applications of Raw and Activated Cod Liver Oil. B. Disturbances Associated with the Active Dental Caries of Childhood and Pregnancy. from the American Journal of Diseases of Children. January, 1927

If dentistry is ultimately to serve humanity as best it may, it will concern itself more and more earnestly with the role that dental infections are playing in the degenerative diseases which largely cause incapacity and premature death in civilized communities. Since the only ideal procedure for the correction of the present injuries of dental infection, would be the prevention of the dental disturbances, the primary responsibility of dentistry comes to be the prevention of diseases of the teeth, and their supporting structures. The newer dentistry should become one of the prevention of dental caries, and pyorrhea. We have no responsibility as dentists comparable to that of learning the cause of dental diseases, and of instituting methods for their prevention.

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(3) Wood, Edward J.: Amer. Journ. Med. Sci., clxix, No. 1, no. 634, p. 28, January, 1925

(4) Reese and Beigler: Subacute combined degeneration of the spinal cord in pernicious anemia. Amer. Journ. Med. Sci., February, 1926.

Figure 1. An apparent reduction of periapical involvement about mesial root of first molar which has a putrescent pulp. Tooth was not treated.

Figure 2. A group of Patients with Chronic Dental Infections showing characteristic Depression of Polymorphonuclears and Increase of small lymphocytes

Figure 3. Chemical changes in blood of a rabbit which developed severe anemia from oral culture from patient with pernicious anemia.

Figure 4. Pathologic changes in the blood of a rabbit inoculated with streptococcus strain from the mouth of a patient with pernicious anemia.

Figure 5. Cultures taken from pyorrhea pockets of patients suffering from same. A, a paralysis of side of the face, and part of side from placing culture in stomach by stomach tube. B, and C, blood cell changes produced in rabbits. D, blood smear from patient with anemia.

Figure 6. Dental Infections and Diabetes. Diabetics have marked tendency to decalcification and to pyorrhetic infection. This case is typical with regard to absence of rheumatic group affections in both patient and family.

Figure 7. A typical blood picture before and after treatment of pyorrhetic conditions. These patients often break rapidly with metabolism disturbances after a lifetime of good health.

Figure 8. First and second lower molars shown in A and B, above, and their roots, with granulomas, after extraction, as shown in A and B, below. The granulomas are larger on the second molar than on the first molar, though their presence is not revealed roentgenographically.

Figure 9. Chamber in bone at different angles: A, as made by a metal bar, producing a chamber one-fourth by one-fourth by one-half inch; B, appearance of chambers in separated bones; C, appearance with rays in line with the long axis of the chamber; D (10 degrees), E (20 degrees), F (30 degrees), G (60 degrees), and H (90 degrees) at different angles: I (90 degrees), the two pieces seaprated and roentgenographed at right angles to the long axis of the chamber. The bent wires indicate the angles. There is practically complete disappearance of this large chamber.

Figure 10. Limitations of roentgen-ray to disclose chamber in bone: A, square end punch in position; B, perpendicular roentgenographic appearance of chamber; C, right angle appearance of chamber. A zone of condensed bone obstructs the view in B.