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Original Articles

SOME BLOOD CULTURES IN CHILDREN AND THEIR SIGNIFICANCE.*

THOMAS MORGAN ROTCH, M. D.

AND

HARRY CHAMBERLAIN LOW, M. D.

BOSTON.

Although blood cultures in the living have for some time been extensively employed, and have assumed the position of an important modern diagnostic measure, yet very little has been done in this direction in early life, in cases in which the blood has been obtained and examined by modern technic. The earlier methods of procuring the blood, as by puncture of the ear or the finger, have proved to be so unreliable from contamination that such reports as that of Delestre's series of 40 cases of children under four years of age, and in which the blood was obtained from the ear in which bacteria were found in 14 cases, are of little value in the light of modern investigation.

Although Hektoen has reported blood cultures in 9 cases of scarlet fever in children, and Somers has reported streptococci in the blood of an infant six months old during a mild attack of icterus, and while Fischl found the pneumococcus in a child sick with pneumonia, nevertheless, a review of the literature relating to this subject in children shows that it is exceedingly meager.

So far as diagnosis and prognosis are concerned, it is probable that the knowledge which we require from blood cultures will be found to be the same in children as in adults. When, however, we consider how the same diseases in young children show such different phases and such a varied symptomatology in comparison with adults, there is no doubt that the detection of a specific organism in the blood will be of utmost importance in differentiating not only doubtful cases of typhoid, pneumonia and meningitis, but also the exanthemata, osteomyelitis and many obscure septic conditions.

It is with this idea that we have thought it worth while to place on record such a limited number of cases, as have come under our personal observation in hospital and private practice, with a view to encourage others to employ this method of investigation and thus by their reports of a large number of cases to add to our knowledge of the subject.

VALUE OF BLOOD CULTURES.

A complete review of what has been accomplished by the study of blood cultures in adults would hardly come within the scope of a paper of this kind, which is intended to deal with the earlier periods of life. A few words, however, regarding what has been done in adults

will indicate more clearly to what class of cases we can with profit turn our attention in children.

The value of blood cultures in children has been especially impressed on us in our hospital work in which many cases come under our care with such indefinite and misleading histories as to render any additional method of examination which we may offer as an exact means of diagnosis of the greatest practical importance. In addition to this, and according to our frequent personal observations, in many cases the clinical picture of sepsis is often present, and yet the cause of the sepsis is exceedingly doubtful. At another time we may have such a clinical picture and yet sepsis may not necessarily be present. In many cases of autointoxication, including often those known as acetonuria, the clinical symptoms are very suggestive of a severe septicemia, and though this apparent septic condition may be relieved by the administration of alkalies, it is nevertheless true that in the absence of a positive culture from the blood we are aided in the diagnosis of autointoxication.

In cases of this kind a blood culture is the only definite means by which we can determine whether sepsis is or is not present, and still further we may in this way establish the etiologic factor. This in itself constitutes a great advance in clinical diagnosis. In regard to treatment, the true value of serum therapy can never be attained until a bacteriologic examination of the blood has determined the special organism with which we have to deal.

Earlier observations on cultures of the blood were not only unreliable from a faulty technic by which the blood was allowed to become infected from external sources, but from the fact that the examinations were made with too small quantities of blood. Year by year, however, advances have been made in the technic, until now a large number of observations are undoubtedly reliable. This class of investigations has been made not only to ascertain whether a specific disease, such as typhoid fever, is present, but also if any organism may be found which could possibly be the etiologic factor of an otherwise obscure group of symptoms, also if in any of the diseases of unknown cause, but well known symptomatology, a causative organism can be found.

A large number of organisms have been found in the blood. Among these are: Many varieties of the streptococcus and staphylococcus, *Diplococcus lanceolatus*, *B. anthracis*, *B. pyocyaneus*, *B. proteus vulgaris*, *B. typhosis*, the bacillus of glanders, the spirillum of relapsing fever, Friedlander's bacillus, the bacillus of tuberculosis, the gonococcus, *Diplococcus intracellularis meningitidis*, and also the paratyphoid bacillus, the bacilli of the pest and of lepra, the vibrio of cholera, the colon and para-colon bacilli, and the bacillus of tetanus. Micro-organisms have also been found in the blood in such diseases as chorea, rheumatic fever, scorbutus and pertussis, but the specific organism in these cases has not yet been determined.

* Read in the Section on Diseases of Children of the American Medical Association at the Fifty-seventh Annual Session, June, 1906.

Thus bacteriemia, occurring from microbic infection of the blood, explains in varied degrees the phenomena exhibited in many different diseases. Sometimes, as in gonorrhea, it is followed by an arthritis or an endocarditis. It is at the same time common in typhoid fever and rather rare in diphtheria.

In connection with this subject, relating to children, it is interesting that the acute infections which etiologically we know least about, and which are therefore especially important for research, occur most frequently in children and yet the previous investigations have been carried out almost entirely in adults. Is it not time, therefore, that the attention of investigators should be turned to this fact, and every encouragement given to make blood cultures in children?

ILLUSTRATIVE DISEASES.

Typhoid Fever.—Bacteriologic examination of the blood is especially valuable in typhoid fever, and even more in young children than in adults, as the early symptoms are so much more obscure and the whole course of the disease so mild that additional evidence is frequently needed even to differentiate the disease from an anemic debilitated condition. It is also generally the fact that typhoid can be distinguished from paratyphoid fever in the early stages of the disease only by blood cultures. It is significant that the bacillus of typhoid fever is not only found in the blood in a very large proportion of cases (it is probably present in all), but that which is of great importance is that it is found very early in the disease while the temperature is still rising, and often many days before a Widal reaction is obtained. Also when the Widal reaction is doubtful, the blood culture may show a positive result. We should consider also that in a number of cases of acute miliary tuberculosis the tubercle bacillus has been isolated in the blood, and that by thus changing a doubtful diagnosis to an exact one, the prognosis has at once become very grave. Schottmüller and others have found a positive blood culture in typhoid fever as early as the first and second days of the fever, and it often may persist to the end of the third week. After distinct intermissions of the fever the bacilli of typhoid have been cultivated in the first twenty-four hours of a relapse. Burton and Coleman in a report of 21 cases of relapse in typhoid fever, obtained a positive blood culture in all but three. In three cases in which the diagnosis was supposed to be scarlet fever, Hektoen found by blood cultures a bacillus of typhoid at a time when there were no typhoidal symptoms.

Scarlet Fever.—In a report of 100 cases of scarlet fever Hektoen found streptococci in 9 per cent. of the mild cases and 27 per cent. of the severe cases. Ten per cent. of the positive results occurred in the first five days. In 237 cases of scarlet fever taken from the combined results of Slawyk, Klein, LeMoyne, d'Espine, Merv, Hektoen and Seitz, streptococci were found in 10 per cent. Jochmann made cultures in 161 cases of scarlet fever and found streptococci in 25 cases. The clinical aspect of the children who had streptococci in the blood did not differ from those other cases which were very sick, but gave negative blood cultures. Of those cases showing scarlatinal nephritis during the fever, streptococci were present in the blood shortly before death in 50 per cent. Although Slawyk reports finding streptococci in the blood in measles in 32 per cent. of his cases, nothing of a definite character has appeared in the general work on this disease.

Many observers have reported different types of streptococci or diplococci more or less carefully differentiated as the etiologic factors in scarlet fever and measles, but as yet there have been no results which would justify us in considering that the true causes of these exanthemata has been discovered. The finding of streptococci in the blood in these cases may simply be the evidence of a secondary infection as it often occurs in diphtheria, along with a general infection by the true etiologic organism.

Diseases Arising from Pneumococcus Sepsis.—Owing to the common occurrence of otitis media in young children, it is of great interest to note that investigations have shown that otitis media and we may also add, pericarditis, may be due to a primary infection with the pneumococcus and that certain cases of lobar-pneumonia seem to be a secondary localization of the primary blood infection originating in some other place than the lung. The observations of Prochaska, Bruh and Fiessinger seem to show that a pneumococcus sepsis may occur without a true pneumonia and Herrick also found a general infection in a case of pneumococcic arthritis. According to Hektoen's work, pneumococci are present in the blood of nearly all patients sick with pneumonia. Pneumococcemia, therefore, does not necessarily mean a severe type of pneumonia, but in obscure cases its recognition will be valuable in diagnosis and also in treatment when serum therapy has been more fully developed.

Cerebrospinal Meningitis.—Since Gwyn in 1899 isolated the meningococcus from the blood in a case of cerebrospinal meningitis, and Warfield and Walker reported a positive culture of the meningococcus from the blood in a case of endocarditis, a number of observations such as Elser's 41 cases with 10 positive results have shown that the disease is often a bacteriemia in the same sense as is typhoid fever. So far, however, as the diagnosis is concerned, unless the blood culture will be found to show the organism at an earlier period than does the spinal fluid, it will not be of great value, because the examination of the fluid obtained by lumbar puncture is easier and just as constant in its results.

Although some of the recent observations of Gwyn, Andrewes and Walker have described a general blood invasion in the course of cerebrospinal meningitis, our observations both in cultures from the living and at autopsy, agree with the opinions of Netter, Councilman, Heubner and Weichselbaum, that this organism very rarely occurs in the circulating blood. Elser's observations showed that where one method failed, the other did also. Judging, however, from Elser's work, cases of cerebrospinal meningitis were most severe and offered the worst prognosis when the cocci were found in the blood.

PRACTICABILITY IN EXAMINATION OF YOUNG CHILDREN.

Many more illustrative diseases could be spoken of which would show that the clinical bacteriology of the blood should be more thoroughly studied, and will probably in the future be of greater value. At present, however, we are especially concerned with the practicability of this method in the examination of young children. Can it be done as frequently in children as in adults? Are there any objections to it? It has been so often stated that the proper technic could not be carried out in young children on account of anatomic difficulties that we have tried to determine whether this statement is correct by having the veins of many infants and children examined with reference to this point.

Our observations were made mostly at the Children's and Infants' Hospitals. The arms were examined in

680 cases and tabulated so as to show the percentage of cases of each age in which the technic could be carried out with a reasonable prospect of success. The youngest positive case is 6 months old but we have succeeded in obtaining sufficient blood for our cultures from the arm of a child even younger than this, and Hummell has succeeded in an infant 5 days old. It must be understood, however, that such a method of determination is only a provisional one and that an actual trial in the special case is necessary to prove whether the blood can be obtained or not. For instance, we have found that when apparently it would be impossible to introduce the needle successfully, it has been done easily, and sometimes, though much less commonly, the reverse has happened. Of the 680 cases under the age of 13 years, that were examined with regard to the possibility of easily obtaining sufficient blood for a culture, 39 per cent. were positive and 61 per cent. negative. In the first four years the positive cases were 21 per cent. and the negative 79 per cent. In the second four years the positive cases were 72 per cent. and the negative 28 per cent. And in the last group, which included the five years from 8 to 13, the positive cases were 86 per cent and the negative 14 per cent. This seems to show that though the younger the child, the less likely will a blood culture be possible; yet in a large number it is possible, and it should be attempted when any important information may be obtained.

As the number of diseases spoken of in this paper at any length in which blood cultures have been made is very small, and is merely mentioned for purposes of illustration, we have appended a list of the articles from which we have drawn our conclusions concerning the cultures made from living blood, and hope that this literature may be of service to those who are interested in the subject.

TECHNIC.

In reviewing the work that has been done in studying the bacteriology of the blood, we have seen many conflicting statements and often the etiologic importance of many organisms has been claimed without sufficient proof. Observers have undoubtedly been led by their enthusiasm to form conclusions with much too meager proof of their convictions. Through a lack of knowledge of bacteriology many have failed in their work, but probably the unreliability of most of the results and the little confidence that we can repose in them is due to a faulty technic in the taking of the blood and the growing of the cultures.

Sufficient quantity of blood may be procured by cupping (Petruschky), but the chance of contamination is great. Immediate animal inoculation with the blood from a patient is rather impractical and not necessary. The simple method of aspirating a superficial vein with a canula or syringe is satisfactory from nearly every point of view. In adults, except in extremely anemic cases, and a rare individual with a very anomalous venous system, one can always procure sufficient blood with little difficulty.

Our list of cases shows the probability of obtaining a good amount of blood in children and our practice has led us to believe that these percentages are rather low, for many of the cases in which the superficial examination of the veins gives little promise of success, turn out to be favorable when the attempt is made. After a careful examination of the superficial veins of many children it is clearly evident that at the bend of the elbow is offered the best opportunity for procuring blood. In

the groin or the popliteal space one may find superficial veins but the chance of causing a hematoma by wounding an artery is possibly greater. Though this may be considered, we know of no case in which it has occurred, and indeed as the vein itself is often pushed aside by the needle, the chances are that an artery would be in little danger of being injured. At all events, the only case in which we have seen any trouble from subsequent hemorrhage was in the aspiration of a child with hemophilia, after which a hematoma of considerable size formed, but under a bandage it quickly disappeared and no ill results followed. Generally, the needle enters the vein and the blood is slowly sucked into the syringe, and when this is removed the walls of the vein collapse, and there is no need of any dressing or bandage to stop the bleeding. Occasionally, the needle wounds or tears a vein or, entering it, slips out again before the blood is drawn, and in these cases we may obtain the blood from a small hematoma which immediately becomes visible. In such cases we have had little difficulty in obtaining the blood or in stopping the subsequent hemorrhage.

We know that there is nothing to fear and that there will be no ill results if this procedure of taking the blood is carefully followed. There is no danger of severe bleeding, and there should be no danger of infecting the patient because unless we can be sure of carrying out the whole process in a perfectly sterile manner, there is no use in making bacteriologic examinations of the blood. We all know, however, that it is rare that an extraneous infection results from the use of the hypodermic or antitoxin needle which often is not too carefully sterilized. Though we have yet to learn of the infection due to the taking of blood from a vein, we mention this fact because the question is often brought up.

METHODS.

The skin about the elbow should be scrubbed with soap and water and then with ether and alcohol and a corrosive pad tied on. No further precaution than this is necessary as there is little chance that the point of the needle will carry in any infectious organism.

Occasionally we have used ethyl chlorid but have found that it caused a superficial anemia and lessened the chances of obtaining sufficient blood. The pain of the needle is slight and short and in children it is the fear of what is going to be done rather than the act that hurts. An assistant places a gauze bandage, towel or rubber Esmarch strip about the arm a few inches above the elbow. This is passed around only once so that it can be loosened or tightened at will. By bending the elbow, rubbing the forearm and occasionally loosening and constricting the bandage, the distension of the veins may be accelerated. We have not found that a hot compress applied beforehand is of any advantage in causing greater distension of the veins.

A simple glass antitoxin syringe (holding 15 to 25 c.c.) with asbestos packing and the ordinary needle serves every purpose. This can be easily and thoroughly sterilized and the needle being attached by short rubber tube (the shorter the better) allows flexibility. The most important thing is to have a perfectly air-tight syringe. We have sometimes sterilized large test-tubes sealed with a cork stopper through which pass two small glass tubes plugged with cotton. One of these is connected with an aspirating syringe and the cotton is removed from the other, and the short rubber tube with the needle is attached. By this method one can keep up a continuous and perfect suction and the difficulties

experienced with a leaky syringe are obviated. This method is of especially great advantage in aspirating the heart after death when considerable suction is often needed.

The needle or canula is thrust into the skin in a line with the vein, which may be steadied between the thumb and finger to prevent its rolling to one side. The most prominent of the veins is chosen and this varies in different individuals. It is immaterial whether the needle be directed up or down the arm. If the first thrust does not strike the vein, the needle can be partly withdrawn and another attempt will generally find the vessel. Occasionally we have failed and subsequently tried a less prominent vein and been successful. Out of 42 cases attempted in children, sufficient blood has been obtained 36 times.

Often in surgical cases we have availed ourselves of the excellent opportunity offered at operation to obtain considerable blood in a syringe without using the needle. In cases in which the knowledge obtained by blood culture might be expected to be of great importance in diagnosis or treatment, and there is difficulty in obtaining the blood in the usual manner, a vein can be laid bare by open incision, and the blood easily secured. To insure a satisfactory examination one should take at least 5 c.c. of blood. In many cases we have easily obtained 15 to 20 c.c. and have often obtained positive cultures from less than 1 c.c.

The culture media should be immediately inoculated with the blood and this is best done by cutting the rubber tube with sterile scissors and squirting directly into the culture tubes. If it is attempted to do this through a needle, clots may have formed even in a minute or two, which will block the passage. If agar plates are to be used, of course, a media must be ready at the bedside at a temperature of about 44 C. In most of our cases we have used four agar plates, four bouillon tubes and two or three small flasks containing about 30 to 40 c.c. of bouillon. The bouillon has been both plain and glucose, made from lean beef and this has been also used as a basis for the agar. Blood serum tubes sometimes smeared with fresh human blood have also been used in certain cases. It has been our experience that bouillon is the most satisfactory for immediate inoculation and that agar plates can be made from this a few hours or a day later, either before or after a visible growth has appeared. In such case a media with extra high percentage of agar was used to make up for the bouillon added. We have found that the small flasks holding 30 to 50 c.c. of bouillon were most satisfactory as in these the blood was sufficiently diluted to lessen any bactericidal properties that it might possess. The ordinary tube or plate should be inoculated with 0.5 c.c. of the blood, but when any considerable quantity can be obtained we have inoculated the bouillon flasks with 2 to 3 c.c. These cultures have been placed in the thermostat at the body temperature and studied in the usual manner to determine the identities of the organisms.

The only cases that we mention of aspiration of the heart were done within a very short time after death. Canon and others have shown that even in removing the body from the ward a spread of the organisms may take place. But as these cases were done in children which are easily carried and in whom it is very simple to reach the heart with a needle, the results are probably quite reliable. In these cases the technic was in every way the same as in the others except that the long aspirating needle connected with the sterile test-tube and the aspi-

rating syringe were used. It was easy to reach the heart in the fourth intercostal space, either just to the right or the left of the sternum and there was little danger of infection from the pleural cavities.

LIST OF CASES.

- CASE 1.—Osteomyelitis. Patient 4½ years old. *Streptococcus pyogenes*. Died.
 CASE 2.—Unresolved pneumonia and empyema. Patient 6 years old. *Pneumococcus*. Recovered.
 CASE 3.—Bronchopneumonia and septic phlebitis. Patient 7 years old. *Streptococcus pyogenes*. Died.
 CASE 4.—Bronchopneumonia. Patient 7 years old. Negative result. Recovered.
 CASE 5.—Pneumonia with general septicemia (?). Patient 2½ years old. Negative result. Recovered.
 CASE 6.—Dermatitis medicamentosa (bromid). Patient 11 years old. Negative result. Recovered.
 CASE 7.—Acute lymphatic leukemia. Patient 9 years old. Negative result. Died.
 CASE 8.—Rheumatic pericarditis. Patient 9 years old. Negative result. Recovered.
 CASE 9.—Diabetes insipidus. Patient 3½ years old. Negative result. Died.
 CASE 10.—Hydrops articularis intermittens. Patient 8 years old. Negative result. Recovered.
 CASE 11.—Acute serous arthritis. Patient 6 years old. Negative result. Recovered.
 CASE 12.—Pneumonia (fifth day). Patient 5 years old. *Pneumococcus*. Recovered.
 CASE 13.—Endocarditis. Patient 6 years old. Negative result. Recovered.
 CASE 14.—Acute arthritis. Patient 7 years old. Negative result. Recovered.
 CASE 15.—Acute arthritis. Patient 6 years old. *Streptococcus*. Recovered.
 CASE 16.—Chronic and acute arthritis. Patient 9 years old. Negative result. Recovered.
 CASE 17.—Typhoid. Patient 6 years old. (Twelfth day.) Positive. Recovered.
 CASE 18.—Typhoid. Patient 10 years old. (Eighth day.) Positive. Recovered.
 CASE 19.—Typhoid. Patient 8 years old. (Fourth day.) Positive. Recovered.
 CASE 20.—Typhoid. Patient 9 years old. (Seventh day.) Negative. Recovered.
 CASE 21.—Typhoid. Patient 7 years old. (Fifth day.) Positive. Recovered.
 CASE 22.—Typhoid. Patient 10 years old. (Sixth day.) Negative. Recovered.
 CASE 23.—Typhoid. Patient 9 years old. (Seventh day.) Positive. Recovered.
 CASE 24.—Typhoid. Patient 6 years old. (Sixth day.) Positive. Recovered.
 CASE 25.—Acute endocarditis. Patient 7 years old. *Pneumococcus*. Recovered.
 CASE 26.—Chronic endocarditis, during acute attack. Patient 12 years old. Negative result. Died.
 CASE 27.—Rheumatism with functional heart murmur. Patient 9 years old. Negative result. Recovered.
 CASE 28.—Chorea. Patient 10 years old. Negative result.
 CASE 29.—Chorea. Patient 11 years old. Negative result.
 CASE 30.—Chorea. Patient 7 years old. Negative result.
 CASE 31.—Peritonitis. Patient's age not known. *Streptococcus pyogenes*. Died.
 CASE 32.—Acute idiopathic peritonitis. Patient 2 years old. *Pneumococcus*. Died.
 CASE 32.—Acute suppurative hip. Patient 9 years old. *Staphylococcus pyogenes aureus*. Died.
 CASE 34.—Cerebrospinal meningitis. Patient 6 years old. Negative. Died.
 CASE 35.—Cerebrospinal meningitis. Patient 3 years old. Negative. Died.
 CASE 36.—Cerebrospinal meningitis. Patient 3 years old. Negative. Died.

CULTURES MADE POSTMORTEM.

- CASE 37.—Endocarditis. Patient 5 years old. *Streptococcus*.
 CASE 38.—Peritonitis, after appendectomy. *Streptococcus*.
 CASE 39.—Osteomyelitis (hip), *Staphylococcus pyogenes aureus*.
 CASE 40.—Acute endocarditis. Patient 6 years old. *Pneumococcus*.
 CASE 41.—Chronic endocarditis. Patient 9 years old. Negative.
 CASE 42.—Cerebrospinal meningitis. Patient 4 years old. Negative.
 CASE 43.—Acute miliary tuberculosis. Patient 3 years old. Negative.
 CASE 44.—Tuberculous meningitis. Patient 5 years old. Negative.

Of the fifteen positive cases in this series, in all except those of typhoid fever, two cases of pneumonia, and one of arthritis, the patients died within a few days. There is too small a number of cases of any one disease to allow us to draw any very definite conclusions.

Case 1 is of sufficient importance to deserve a special notice.

History.—The child had suffered from an aural discharge for six months. Two weeks before admission the discharge increased and in the preceding five days the patient had vomited frequently, complained of frontal headache and tenderness in the left shoulder and right hip, and had a high fever

at night. The child was fretful and extremely hyperesthetic. The enlargement of the right thigh, the *x*-ray examinations and other general symptoms all pointed to osteomyelitis. Later the pain in this thigh and knee became extreme, and the leg was swollen and glossy. The leucocytosis was only 16,000.

Operation.—An operation just above the right internal condyle showed only edema and no purulent affection of the bone or periosteum.

Blood Cultures.—On the eighth day 18 c.c. of blood were taken from the arm and 20 plants made in various media. Of these 14 showed a profuse growth of streptococci in long chains. Throughout many replants this organism did not change in form, and in every way coincided with *Streptococcus pyogenes*, except that it proved to be only very slightly pathogenic to guinea-pigs. Of six inoculations the only one that died was when a very large amount of the culture was inoculated. A later blood culture gave the same organism. The child grew gradually worse and died eight days later.

Autopsy.—At autopsy thick yellow pus was found in the right and left hip joints, right knee joint, the right sternoclavicular joint, the left shoulder joint and the right middle ear. These all showed pure cultures of streptococcus except the right hip and the right ear, in which *Staphylococcus pyogenes aureus* was also present. There was also an acute serofibrinous pericarditis from which pure cultures of the streptococcus were obtained.

Antistreptococcus serum was given in this case after blood cultures were made. Here was a case which appeared to be clinically either an osteomyelitis or possibly meningitis, and the blood culture determined the general septicemia. Considering the length of time that this child combated a general blood infection with the streptococcus, the organism was probably of very low virulence and if blood culture had been made sooner, serum treatment might have been successful.

Some of the other cases were of value in suggesting treatment, but many only aided in determining the diagnosis. The cases of typhoid fever showed a Widal reaction in all but one instance and the positive blood cultures were thus only confirmative. In one old case of empyema the presence of the pneumococcus was interesting. The value of the recognition of this organism in the blood in pneumonia is evidently in the prognosis and can be of but little aid at present in the treatment. With a better knowledge of the antitoxic sera the value of blood examinations may be increased. These cases have been examined not with any idea of studying one disease or group of diseases, but to obtain some statistics relative to the practicability and value of blood cultures in children. Few of our patients have died and so the percentage of positive results is quite small, and of course in many there was a very slight chance of finding any organisms present. Many of these cases have been obscure as to diagnosis or etiology, and the cultures have served a little in clearing the field of possibilities.

We believe that with our present technic, a negative culture is of value in prognosis, if not in diagnosis and treatment. The early results of many observers who used too little blood and others who found *Staphylococcus albus* as a factor in many cases of septicemia must be doubted. In these early observations many organisms were found and now with more careful and thorough technic investigators have fewer positive results. One is led to doubt the value of the work done by those who claim to find new causative organisms constantly in the blood, especially as they have been reported in scarlet fever and various rheumatic or arthritic conditions. In making bacteriologic examinations of the blood or fluid from the joints or spinal canal, too much care can not be exercised to prevent contamination.

In the later stages of chronic diseases as phthisis, various organisms have been reported in the blood which are probably secondary invasions, similar to the so-called "agonal invasions of the blood" which occur in debilitated conditions when the weakened resistance of the individual fails to overcome the invading organism. The value of blood cultures in which the results are positive is generally recognized, and in children their value is probably greater than in adults. In spite of the difficulties of obtaining the blood in some cases the percentage of practical results in children may prove to be greater than in adults.

The cases in which bacteriologic examination of the blood promises much help are those obscure conditions of so-called "cryptogenetic septicemia" and autointoxication. The great number of cases of endocarditis, chorea, arthritis, and obscure septic infections which occur in children uncomplicated by other chronic disease, offers a large field for the application of this means of diagnosis with a view to the treatment, prognosis and interpretation of the cause of the disease.

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DISCUSSION.

DR. E. E. GRAHAM, Philadelphia, said that often a physician is confronted by a case in which the differential diagnosis of a septic and a non-septic condition is difficult. Blood cultures are of distinctive value whether or not a special organism is found. If the case is suspected of being tuberculous it is possible to find the tubercle bacillus, but not finding it does not necessarily prove that the case is not tuberculous. Many cases of concealed pneumonia are cleared up by finding pneumococci. Many cases of typhoid fever in which it would be practically impossible to arrive at a positive diagnosis have been immediately cleared up by blood cultures.

DR. T. R. ROTCH, Boston, emphasized the fact that merely finding the pneumococcus in the blood does not show the patient to have pneumonia. Especially in very young children, with symptoms pointing to pneumonia, is this true, because the symptom of this disease may be of reflex origin and the source of the pneumococcus infection may be outside the lungs. There may be a pneumococcemia and pneumonia not present. Very often a pneumococcus otitis media may cause the presence of the micro-organism in the blood. In acute lobar pneumonia the pneumococcus is almost universally found.

A PHYSICIAN'S CREED, PAST AND PRESENT,
AS TO THE PHYSIOLOGY OF THE HEART.*

WESLEY MILLS, M.A., M.D.

Professor of Physiology, McGill University.

MONTREAL, CANADA.

When honored by the American Medical Association with an invitation to become its guest and to contribute to its program, I cast about to consider in what way I could be of most use to those who might do me the further honor to read my paper when published.

In my opinion, physiologists and physicians have stood too much apart. Although the American Physiological Society has held meetings for a great many years in the different great centers of the country, but few physicians ever attend those meetings or even read the reports of the papers presented, probably because they are usually published in periodicals other than medical.

In most instances teachers of physiology to-day are not men in active medical practice, while many never were doctors, except academically. This has its advantages, but also some disadvantages. Physiology as such, even yet, it is to be feared, is only occasionally brought before the student in the wards of the hospital or elsewhere when once he has passed the examinations on the primary subjects; while the medical investigator has been so occupied with morbid anatomy and bacteriology that a physiologic medicine in the sense of one pervaded through and through with the conception that disease is altered function and the whole of medicine a study of this changed function, can not be said to be the dominant state of mind even yet, though one sees hopeful signs that progress is being made toward it.

Holding these views, I felt the desire to make some contribution that might be directly helpful to the practicing physician and surgeon; for the latter, still more than the former, is apt to indulge in the belief that physiology is somewhat superfluous for his purpose, though I may point out that the surgeon who in our time has contributed most to the advancement of his art, Sir Joseph Lister, was himself a practical investigating physiologist, a fact which has made itself felt throughout his whole career.

* Read in the Section on Pathology and Physiology of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.