wonder what that admirable writer, the author of "Ecclesiasticus," would have said had he lived in these days? He who, referring to his own times, wrote that "of the works of the apothecary there is no end, and from him there is peace all over the earth"? I think "Ecclesiasticus" might be oftener read than it is; and so it would be, said Addison, if "such shining tracts of morality had appeared under the name of Confucius or of any celebrated Grecian philosopher." How admirable is the following and how excellent its precept! — "The Lord hath made medicines out of the earth: he that is wise will not abhor them." Also this: "He that sinneth let him fall into the hands of the physician." I strongly recommend a medical reading of "Ecclesiasticus." It may not be quite so instructive as "Don Quixote," recommended by Sydenham to Sir Richard Blackmore as the best medical treatise of his time, but it will certainly prove interesting and very soothing to the *amour propre* of our profession.

We must not, however, discourage pharmacological research and effort altogether, for the practitioner of 1801 had neither iodides nor bromides; no chloroform, pepsine, carbolic acid, cocaine, nor quinine; no salicylates; no chloral; no morphine; nor strychnine, nor atropine; and how could we practice without these and many others now?

Seeing how large is our modern armamentarium, and how undoubtedly effective many portions of it are, one would be inclined to pity the practitioner of 1801, were it not equally certain that the practitioner of 2001 will pity us.

As regards the practice of today, that middle point of the centuries to which I referred, it is not too much to say that the whole realm of nature — animal, vegetable and mineral — has been ransacked to find remedies against disease. Not only so, but every available physical force — heat, light and electricity — have been pressed into the same service.

It is in the use of antitoxins and animal extracts, however, that the most remarkable advances have been made; and I would ask once more how could we get on today without diphtheria antitoxin and without thyroid extract?

"If they do these things in a green tree what shall be done in the dry?" I must leave it to others to predict the therapeutical standpoint of 100 years hence. This much, however, may be safely affirmed: that as the general public of today expects to be cured with all expedition, the public of the future will expect even more in proportion from the practitioner of 2001.

(To be continued.)

ACCORDING to the *Philadelphia Medical Journal*, a German society for the study of medicine and the natural sciences has recently been formed. The committee of organization consists of Prof. G. W. A. Kahlbaum of Basel, Prof. J. Pagel of Berlin, and Dr. Sudhoff of Hochdahl. The society will hold its first annual meeting after the close of the meeting of the Association of German Scientists and Medical Practitioners.

Original Articles.

PRACTICAL BLOOD EXAMINATION.[1]

BY HENRY F. HEWES, M.D., BOSTON.

AMONG the special methods of the study of disease which have been developed in this recent era of laboratory methods, one of the most important and practical in the aid which it lends us in the understanding and diagnosis of our cases is that of the examination of the blood.

The usefulness of this method as a clinical procedure rests first upon the value of the knowledge obtained by its application in connection with the diagnosis of many of the diseased conditions commonly encountered in general practice; and second, upon the simplicity as regards technique of the methods involved in this application, a simplicity which fits the examination perfectly for routine use in clinical work. Experience of 10 to 20 years in blood examination has established for us very definitely the scope of this method in the diagnosis of disease, and has given us a set of very practical methods for its accomplishment.

The scope of practical blood examination established by use at the present time is, stated briefly, as follows:

(1) The determination of the existence or nonexistence of the condition of anemia, and if such a condition is present, of its severity and type, including in the latter determination the diagnosis of pernicious anemia.

(2) The determination of the existence or nonexistence of the condition of leucocytosis, and, if such a condition exists, of its extent and type, this including the diagnosis of the conditions of myelogenous and lymphatic leukemia.

(3) The determination of the presence or absence of blood parasites, this including the diagnosis of the condition of malaria, that of filaria sanguinis hominis and that of relapsing fever.

(4) The determination of the existence of definite serum reactions in the blood, as, for example, the Widal test for typhoid.

(5) The determination of presence in the blood of bacterial organisms; that is, of septicemia.

The accomplishment of these determinations is the scheme of practical blood examination. Barring the tests for bacterial infection, the determinations of septicemia and the serum reactions, which, involving as they do some practical knowledge of bacteriology and of culture methods, form a special branch of blood examination, this whole scheme of practical blood examination giving the diagnosis of anemia, of leucocytosis, and of the presence of blood parasites, and comprising today nine-tenths of all clinical blood work, may be accomplished by the employment of two very simple methods of examination. These methods are (1) the estimation of the hemoglobin, and (2) the examination of a stained specimen of blood. Other methods, as the examination of fresh specimens or the enumeration of the corpuscles by special

[1] Read before The Massachusetts Medical Society, June 12, 1901.

counting methods, may confirm and add to our knowledge as to the condition of the blood; but the simple procedure mentioned, consisting of the performance of these two methods, will give us our aid to diagnosis, where such aid is obtainable from blood examination, without the use of further methods.

The procedure of these two methods is as follows:

For the estimation of the hemoglobin we have a very simple method known as the Tallqvist method. For its employment we need as apparatus simply a needle to draw the blood and one of these specially prepared books known as the Tallqvist hemoglobin books.

This book contains specially prepared porous paper, which will soak up the blood, and a color table. This color table contains ten color plates, the top one representing the color obtained by soaking the special porous paper of the book in a blood containing the normal amount or 100% of hemoglobin. The next plate is a facsimile of the color obtained by the use of a blood containing 90% of the normal hemoglobin. Each succeeding plate represents the color effect of a blood of 10% less color richness than the one above it, until the last plate represents a blood of 10% hemoglobin.

To perform the test it is necessary to prick the ear or finger so that the blood flows without pressure, and draw off a drop or two in the porous paper, allow the blood to dry, and then compare the specimen at the moment of dryness (not earlier or later) with the color table. If the color corresponds to that of the 100% plate, then the hemoglobin content of the blood is normal; if to the fifth plate, it is 60%, and so on.

This test tells us at once and without further testing whether or not a condition of anemia is present.

For the preparation of a stained specimen there are necessary a half dozen thin glass cover slips ($\frac{7}{8}$ square slips are the best), a needle, an alcohol lamp or gas burner, or some chemical fixing material, as absolute alcohol, for fixing the blood, a staining mixture for the staining, and a microscope with an immersion lens for the examination.

Thin spreads are made upon the cover slips by dropping one containing a drop of blood upon a clean slip and sliding them apart after the blood has spread. These spreads are dried in the air and then fixed. A simple method of fixing is to hold the cover slip in nippers for two minutes above a flame, at a point just too hot to hold the hand for any length of time. By practice the correct point with an alcohol lamp or gas burner can be determined. For heating a number of specimens a copper plate kept at a constant temperature over a flame, or a constant temperature oven may be used. The heat required in the oven or on the plate is 110° to 120° C. for five minutes' time. The fixed blood is then stained by an appropriate stain.

The object of staining blood in clinical work is to enable us first to differentiate the varieties of leucocyte present, second to discover the malarial parasite if present, and third to distinguish any nucleated red corpuscles present. The leucocytes of blood have been found to be of three varieties, according to their staining reactions or affinities. One form takes by preference an acid stain in its protoplasm, another a neutral stain, and the third form a basic stain. So to differentiate our leucocytes we must subject blood to all three kinds of stain, or to a staining mixture containing all three stains. This is what is meant by an appropriate stain. Such a staining mixture we possess in the commercial stain known as the Ehrlich triple stain or three-color mixture. This mixture, composed of two acid stains, acid fuchsine and orange G, and one basic stain, methyl green, contains at the same time an active acid, neutral and basic element, staining the protoplasm of the acid leucocytes, the acidophiles or oxyphiles (eosinophiles), red or golden red, that of the neutral leucocytes or neutrophiles, lilac, and that of the basic leucocytes or basophiles, blue. The elements of the protoplasm taking these special stains are fine granules scattered through the basal substance, which remains unstained. The nuclei of all the leucocytes stain blue with the basic elements of this stain. The red corpuscles take a golden color with this stain; the nuclei of any nucleated red corpuscles, if such are present, take the blue basic stain. In order to get constant and definite results with this Ehrlich method of staining it is found necessary frequently to modify it somewhat by the application of a second purely basic stain to the blood subsequent to the regular Ehrlich mixture. This modification brings out much more definitely than the simple Ehrlich mixture, the basophilic granules in the protoplasm of the basophiles, and makes the differentiation of the three types of leucocyte a much simpler process than in the original method. It also makes the differentiation between nucleated red corpuscles and the round nuclear leucocytes — the lymphocytes and other basophiles much more definite, and finally stains the malarial parasite, a result which the simple Ehrlich method often fails to accomplish.

This modified Ehrlich method of staining therefore attains all the objects of blood staining as above enumerated.

The process of staining is as follows:

The blood properly fixed is stained for two minutes in an Ehrlich three-color mixture. A useful formula for making up this mixture is the following:

Ehrlich-Biondi-Heidenhain; three-color mixture	1.5 gr.
Acid fuchsine	0.4 gr.
Absolute alcohol	2 cc.
Water (distilled)	15 cc.

The specimen is then washed and stained for one-half second to two seconds in Loeffler's alkaline solution of methylene blue.

The specimen is then washed, dried and mounted in balsam. By the use of this method of blood examination, a process necessitating, save for the microscope, the simplest forms of apparatus, and taking for its application in simple cases fifteen minutes, in complex ones perhaps an hour, we can

determine in a given case the existence or non-existence of a leucocytosis and its type, the presence or absence of blood parasites, and if anemia be present, as proven by the hemoglobin test, its type.

The diagnosis of the type of anemia by this examination of a stained specimen is a simple matter. We have in the various diseases which have anemia as an associate, from the point of view of the blood finding, a considerable variety of anemias. Among these, however, no variety is characteristic of any one special clinical condition as distinguished from other conditions having anemia associated, save one; namely, that variety associated with the symptom complex or diseased condition known as pernicious anemia. So for practical work it is essential to determine but two types of anemia in the blood characteristics, the pernicious type and the nonpernicious. In the condition known as pernicious or idiopathic anemia we have a type of blood finding peculiar to this condition, not found, with certain definite exceptions to be mentioned, in the anemias of any other known condition.

The recognition of this type is therefore of much importance, first for diagnosis of the condition, and second because, since prognosis is always, with a single exception to be mentioned, bad where such a finding is present, it gives us a definite line for prognosis in our case. This diagnosis is made as stated by the examination of a stained specimen of blood.

In a specimen of normal blood stained by the modified Ehrlich method, the red corpuscles appear as circular biconcave discs of a diameter averaging 7.5μ and a yellow color marked in the perimeter and faint or absent in the central area.

Their characteristic in normal blood is that of uniformity. The shape is, save where an artefact of spreading, round or slightly oval; the size practically uniform to the eye, though actual variations in diameter from 6 to 9μ are present, the color yellow, and the whitish central areas of the same regular size in all, save where the corpuscles are crushed in spreading, when no white centre appears.

In the blood of a case where the hemoglobin test shows anemia we may find in the stained specimen great variation from this uniform normal picture. We may find that the corpuscles are much paler than in the normal, the white centres of the corpuscles occupying a much greater proportion of the corpuscle. This condition is known as achromia. In some anemias, as that associated with the condition known as chlorosis, this is often the only abnormal characteristic present in the stained specimen. We may find variation in the shape or size of the corpuscles from the normal character. Thus we may see balloon or triangular forms, forms much larger or smaller than normal. The picture becomes one of diversity rather than uniformity. This condition of distortion in size and shape is spoken of as poikilocytosis.

Also in severe anemia we may find present red corpuscles containing nuclei — forms known as blasts. These blasts may be of the size of normal red corpuscles, when they are called normoblasts, or they may be larger than normal when they are called megaloblasts. They stain like the red corpuscles in their protoplasm. The nuclei are as a rule single, very compact in structure, and stain blue or bluish black by the Ehrlich method. The presence of these blasts means a severe anemia. The megaloblasts are of more serious significance than the normoblasts.

All these changes and abnormal forms mentioned may occur in both the pernicious and the non-pernicious anemias. Each and every abnormal form, poikilocytes, macrocytes (large corpuscles), blasts, both normoblasts and megaloblasts, which is found in pernicious anemias, may be present in the very severe anemias following cancer or hemorrhage. The more severe these conditions are the more the blood approaches the pernicious type of anemia. The combination of the abnormal characteristics is, however, always different in the two types, giving a special picture to pernicious blood not found elsewhere.

This special feature of the blood of pernicious anemia is the presence of an excess of large nucleated red corpuscles, or megaloblasts. To diagnose the condition, therefore, we search our stained specimen for blasts, counting separately all normoblasts and megaloblasts. If more megaloblasts than normoblasts are present the condition is pernicious anemia. If the normoblasts are in excess, or if no blasts whatsoever are found in a sufficient search, we diagnose the anemia as of the nonpernicious type.

In addition to this essential characteristic, the blood of a typical case of pernicious anemia has other features which are more or less peculiar to this condition, and hence of some importance in the study of the case.

The first is the existence of a general tendency to increase in the size of the red corpuscles the so-called high-volume index. The existence of this condition is observed in the stained specimen. Large red corpuscles do occur in severe anemias of all types. A marked average increase, however, such a condition that the space necessary to hold a given number of corpuscles is distinctly larger than it would be with normal blood, is rare outside of pernicious anemia. The condition is not, however, present in all cases of pernicious anemia. The existence of this high-volume index may be demonstrated also by the centrifugal method of blood examination.

The second peculiar feature of pernicious blood is the high-color index. This characteristic is determined by the comparison of the estimation of hemoglobin and that of the number of red corpuscles. It is a common but not constant feature of pernicious anemia.

A diminution in the number of red corpuscles, usually a reduction to less than 2,000,000 per cmm., is also a common characteristic of this condition. It is not constant, however, and may occur in other forms of anemia.

The establishment of these additional characteristics is of use in aiding in the complete understanding of our case. The diagnosis is made, however, simply by the examination of the stained specimen, where we can determine the excess of megaloblasts; and also, where present, the existence of a high-volume index.

I have said that this peculiar blood finding of pernicious anemia was limited to this disease with certain definite exceptions.

A similar blood picture is presented by cases of infection by intestinal parasites, as anchylostoma duodenale and bothriocephalus latus. In these conditions the anemia disappears and the case recovers upon removal of the cause. This fact must be borne in mind in deciding upon diagnosis and prognosis in a case with such a blood finding.

In some cases pernicious anemia bloods have been reported as associated with atrophy of the stomach; also a few cases have occurred in association with nephritis and other chronic conditions. These facts simply tend to enforce the opinion which is that generally accepted in regard to pernicious anemia, that it is but a particular form of secondary anemia due to special causes and conditions for the most part unknown, and for the most part in the light of our present knowledge unremovable.

Anchylostoma is one cause of this severe type of anemia which is known and is curable. This opinion is further encouraged by the fact that severe anemias, with cancer or hemorrhage or other causes, as they become more advanced, tend to approach more and more nearly to the pernicious type. The volume index becomes greater, though not as a rule over the normal, the color index nearer 1, and megaloblasts appear, though not in excess of the other blasts.

The diagnosis of a leucocytosis is made by a study of the stained specimen of blood, prepared as above described.

The study of blood has shown that there are present in normal blood from 4,000 to 10,000 leucocytes per cmm. of blood; that is, a proportion of 1-500 to 1-1,000 red corpuscles. The leucocytes making up this total are of three kinds, which are differentiated on the basis of their staining reactions with a triple stain. These three forms are basophiles, cells taking a blue stain in their protoplasm; neutrophiles, cells taking a lilac stain in their protoplasm; and oxyphiles, cells taking a golden red stain in the protoplasm.

These three forms of leucocyte are present, each in definite proportions, in normal blood. Thus in any given blood, of 100 leucocytes 20 to 35 are basophiles, 60 to 75 neutrophiles, and ½ to 5 oxyphiles. So that in 1 cmm. of blood we may have, according as our number of leucocytes is high or low (4,000 to 10,000), from 800 to 3,500 basophiles, 2,400 to 7,500 neutrophiles and 40 to 500 oxyphiles.

A leucocytosis is an actual increase in the number of one or more forms of leucocyte — basophile, neutrophile, oxyphile — over the maximum normal limits; that is, if we have more than 3,500 basophiles or 7,500 neutrophiles in 1 cmm. of blood, we have a leucocytosis. This leucocytosis is named after the kind of cell increased. Thus, if it is the basophiles which are increased actually, we call it a basophile leucocytosis; if neutrophiles, a neutrophile leucocytosis; if oxyphiles, an oxyphile leucocytosis. If more than one form is increased over normal, for convenience we name the leucocytosis after the form which is most increased proportionally to its normal standard, though such a condition is in reality mixed leucocytosis.

To make a diagnosis of a leucocytosis, then, we must determine whether or not the actual number of any form of leucocyte is increased over the normal maximum for this cell. The simplest method of the determination of such an increase, if it exists, is the determination of the presence of an increase in the total number of leucocytes present. If such an increase exists we know that there must be actual increase in the number of at least one special form of leucocyte; that is, that we have a leucocytosis.

For most cases in clinical work this determination may be made by the examination of a stained specimen. Some practice in the study of stained specimens of normal blood and of the blood with various degrees of leucocytosis will enable one to determine with fair accuracy in a given case whether the number of white corpuscles present is within the normal limits or distinctly increased. Where the number is high-normal or slightly increased, this method may leave one in doubt. In such cases, if necessary, the point can be determined by a count of white corpuscles by the Thoma-Zeiss method.

As a rule, where a leucocytosis of sufficient importance to have a distinct bearing on the diagnosis of the cases is present, it is of sufficient degree to be determined by this quick method of estimation of a stained specimen. The determination may frequently be made at a glance. In other cases it is necessary to count the contents of a given number of microscopic fields and compare the results with normal results. It is perfectly true that a leucocytosis may exist without an actual increase in the total number of leucocytes. One form of leucocyte may be actually increased and the other forms decreased. Such a condition can be diagnosed only by a white count, plus a differential count and actual computation of the number of each kind of leucocyte per cmm. The necessity for such a procedure is suggested by the character of the case and the appearance of the blood in a stained specimen. In a great majority of our cases we can and do estimate definitely, for purposes of clinical work, whether or not we have a leucocytosis by the examination of the stained specimens alone. This point determined, we determine its type by a differential count of the leucocytes, naming the leucocytosis for that form of leucocyte most increased proportionally.

The existence of a leucocytosis may also be de-

termined by examining a fresh specimen of blood. This method, however, like the white count, tells us nothing of the type. The importance of the determination of the type of leucocytosis must not be underestimated. The common form of leucocytosis is the neutrophile leucocytosis. It is this form of leucocytosis which accompanies suppuration; many of the infectious diseases, as pneumonia, scarlatina and diphtheria, and many inflammatory conditions. The oxyphile leucocytosis is characteristic of trichinosis, of some skin affections. Its presence often suggests the diagnosis of one of these conditions. The basophile leucocytosis is characteristic of lymphatic leupemia. It is found in children in pertussis and rachitis. The myelocyte leucocytosis is, as stated, characteristic of myelogenous leupemia. And for this determination, both of the existence of a leucocytosis and of its type, we use the method of the stained specimen.

In addition to the forms of leucocytosis mentioned, we have in certain diseased conditions another form known as a myelocyte leucocytosis. This is a condition in which we have an afflux of large numbers of an abnormal form of leucocyte known as myelocytes into the blood. These myelocytes are neutrophilic or oxyphilic cells, resembling in morphological character normal leucocytes, but differing from the normal neutrophiles and oxyphiles in the fact that they are non-ameboid and have as a consequence round instead of the many shaped nuclei of the normal cells.

They are differentiated from the normal cells in a stained specimen by their staining characteristics and this morphology of their nuclei.

These cells are never present in normal blood. They may occur in a variety of diseased conditions. When few in number and unassociated with increase in the number of leucocytes their appearance has no special known significance. When they appear in connection with a great increase in the number of leucocytes, in such numbers that it is evident that the leucocytosis is, in considerable part, due to their presence, we speak of the condition as that of a myelocyte leucocytosis. It is this condition which characterizes the blood of myelogenous leupemia. A recognition of this leucocytosis is therefore important in connection with the diagnosis of this disease.

The parasites which we may find in the blood in disease are the malarial parasite, the filaria sanguinis hominis and the spirillum of relapsing fever. The appearance of these parasites in the stained specimen of blood is as follows:

In a specimen stained by the modified Ehrlich method the malarial parasite appears as a blue body lying within a red corpuscle. The appearance of the organism is dependent upon its age and type. If fully formed, dark pigment will appear scattered through its substance. If in an early stage of development it may appear in the form of a blue signet ring or as a simple sphere without pigment.

Where we suspect the presence of the malarial plasmodium we ordinarily look at a fresh specimen of blood, since the organism is more satisfactorily determined while alive and moving in the blood. Where it is impossible to get to the bedside of the patient at the proper time, the examination of stained specimens will, however, suffice for diagnosis. As stated, we may use the modified Ehrlich staining method for staining malarial organisms. A more satisfactory method for this special purpose is, however, the Jena method.

The Jena staining mixture consists of a mixture of eosin and methylene blue put up in the following manner:

1% Aqueous Solution of Eosin ..... 100 cc.
1% " " " Methylene Blue..... 100 cc.

Allow to stand 24 hours. Filter. Dissolve the precipitate in methyl alcohol to saturation.

This method gives very excellent stains of the malarial parasite. The method of fixing by alcohol preserves the histological structure of the various bodies to be stained more perfectly than the fixing by heat.

This staining method may also be used in place of the Ehrlich method for regular blood staining after one has studied the characteristics of blood by the Ehrlich method. It has the advantage over the Ehrlich method of fixing the blood at the same time that it stains it, giving a constant method of fixing in many ways superior to the fixing by heat. The objection to the method for general work lies in the fact that it contains no neutral staining agent and thus differentiates but two forms of leucocyte — the oxyphile and basophile. It does, however, stain the cell, which would be a neutrophile by the other method, a much fainter red than the oxyphile. So that, possessed of a knowledge of the distinction between these cells, gained from the use of the Ehrlich method, the student has no difficulty in working with this method.

In addition to these methods of practical blood examination, established by experience as useful, there are some recently developed methods of equal practicability for application, but lacking the testimony of extended experience in regard to their usefulness.

Among these, the most important and promising is the test for iodophilia. Recent investigations have shown that if pus, due to the action of the common pyogenic bacteria, be subjected to a special iodine solution, consisting of iodine, 1; iodide of potassium, 3; water, 100; gum arabic q. s. to make syrupy in consistency, certain of the pus corpuscles will show granules in their protoplasm, taking a brownish red stain with the iodine. If blood from a patient suffering from such suppuration be stained with this same mixture, it is found that certain of the neutrophilic leucocytes take this same iodine stain — perhaps 10 in 100 of all leucocytes.

This phenomenon is called iodophilia. It is said to occur in conditions of suppuration, except those due to tuberculosis, and in croupous pneumonia. It is also present in severe anemias and in the leukemias.

As stated, the usefulness of this method is still sub judice. If future experience shall show that it does occur in the stated condition exclusively and constantly, it will offer us an unequalled means of determining the existence of suppuration in a given case, or of distinguishing pneumonia from other infectious conditions.

Other blood phenomena, of recent discovery, which can be determined by simple methods of observation, are the granular degeneration of the erethrocytes in lead poisoning and the peculiar staining characteristics of the blood of diabetes mellitus. As the diagnosis of these conditions can, however, be made more definitely by simpler methods of observation, these tests are not to be considered as necessary parts of practical blood examination.

This, then, with the addition of the serum reaction tests, is the present scope of the blood examination, practical for the regular practitioner in his routine work.

The special application of the knowledge gained by the use of these methods to diagnosis is part of the study of clinical medicine, and must be taken up in connection with the study of particular cases. Its general application can readily be understood from the above review.

Exact knowledge in regard to the presence or absence of anemia in a given case is always to be desired, and where it can be obtained by so simple a procedure as that described in our method should always be secured.

The presence of a leucocytosis is one more fact to help us in deciding what a febrile attack may have as a cause, in diagnosticating pneumonia or suppuration or in ruling out typhoid or malaria.

The determination of its type may make our diagnosis of leukemia, or lead us to the diagnosis of trichinosis.

The finding of parasites is of course of absolute diagnostic value.

My object in this paper has been simply to demonstrate to you the method of procedure necessary for the accomplishment of these diagnoses and to impress upon you the extreme simplicity of the work, in the hope that this examination may be more commonly used in general practice.

RACHITIC DEFORMITIES OF THE SPINE.[1]

BY J. S. STONE, M.D., BOSTON.

THE usual spinal deformity in rickets is a general kyphosis, extending from the lower cervical region downward, and most marked in the lumbar region. It occurs usually pretty early in the course of the disease, and is much more apt to occur in those cases of rickets coming on very early in life than in those coming relatively late. With this kyphosis there is usually associated round shoulders. There are usually no sharp angles, although in the lumbar region the curve is often very marked. Lateral deviation of the spine is much more rare, although it does occur, and if so is of considerable clinical importance. Sometimes in rickets there is a rotation of the spine without much lateral deviation.

In older rachitic children there is at times a greatly increased lumbar lordosis. This condition is particularly apt to occur in fat, heavy children.

In the causation of these deformities muscular weakness is the essential factor. Changes in the ribs and changes in the pelvis and in the legs are factors to be considered. Of course the weight of the large head of rickets is an element in bringing about any bending of the spine. Bony softening is usually of less importance in the spine than in the long bones, the bodies of the vertebræ being largely cartilaginous. Muscular weakness is of much more importance in deformities of the spine than in deformities of the long bones. Deformity of the spine is usually not at all proportionate to the deformities of the long bones, because it occurs usually to the greatest extent in those children who have never walked, but have been propped up in chairs or in bed long before they have attempted to stand, or before their muscles have become strong enough to allow them to support their weight in sitting.

In those weak children who have never stood up the normal lumbar curve has never been formed. There is thus a perpetuation and exaggeration of what is the normal shape of the spine in infancy. In stronger, fatter children the increased lumbar lordosis is necessary for maintaining the erect position when the muscles are too weak to hold the spine with only the normal curves.

Lateral deviation is usually due to some postural cause, often the habit of the mother of holding the child always upon one arm, or may be due to a tilting of the pelvis resulting from deformity of the legs.

The diagnosis of rachitic deformity of the spine is usually easy. It does not occur as a rule except in the more marked grade of rickets. The differentiation from Pott's disease may be extremely difficult, because the lumbar rachitic kyphosis due to rickets oftentimes does not disappear on recumbency, and there may be marked rigidity on attempted extension of the spine. The presence of psoas abscess or marked psoas contraction, or the presence of symptoms of pressure on the cord, would occur in Pott's disease, but not in simple rickets. In some cases time alone will determine the diagnosis, but fortunately the treatment of the two conditions is identical.

It should consist in recumbency upon some firm, even surface, usually most conveniently a properly padded gas-pipe frame. If due to rickets alone the kyphosis will disappear with reasonable promptness. If due to Pott's disease the deformity will persist.

In a few very mild cases in which recumbency is not essential, or in convalescent cases, a light spring brace may be useful, although as a rule

[1] Read before the Boston Society for Medical Improvement, Jan. 7, 1901.