only 1,800. In this case the apparent lymphocytosis is due to an *absolute decrease* in polynuclear cells.

For the reasons here given it seems to me best to use the following definitions:

1. Leucocytosis is an increase in the polynuclear cells beyond the normal—7,000.

2. Lymphocytosis is an increase of lymphocytes beyond the normal upper limit—3,500.

3. Eosinophilia is an increase of eosinophiles beyond the normal upper limit—500 per cubic millimetre.

Occurrence of Leucocytosis.

Leucocytosis, like fever, occurs in a great variety of conditions, of which the following are the most important:

1. In *infectious diseases—except* typhoid, malaria, uncomplicated tuberculosis, measles, smallpox (prior to the pustular stage), mumps, and German measles.

2. In a variety of *toxæmic conditions*, such as uræmia, hepatic toxæmia, diabetic coma, rickets, and poisoning by illuminating gas.

3. In a minority of cases of *malignant disease*, especially sarcoma.

4. After *violent muscular exertion*, including parturition, and after cold baths or massage.

There is in all probability no constant leucocytosis in pregnancy or during digestion.

Leucocytosis is most often of value in the differential diagnosis between typhoid fever or malaria on the one hand, and pyogenic infections (meningitis, appendicitis, sepsis, pneumonia) on the other. A leucocyte-chart is often of value in judging whether a local suppurative process, such as appendicitis, is advancing or receding, or whether pus-pocketing has taken place. By a leucocyte-chart is meant a series of leucocyte counts at short intervals—twelve, twenty-four, or forty-eight hours. *When taken in connection with the other clinical data*, a leucocyte chart is often of the greatest value, especially in following the *course* of any disease; to a less extent in diagnosis. In internal medicine leucocyte counts are especially useful in *febrile conditions*, in the great majority of which they assist the diagnosis.

Certain exceptions to the rules above given must be remembered:

1. *Quiescent*, thickly encapsulated collections of *pus*, in which the bacteria have died or lost their virulence, usually *produce no leucocytosis*. In this group come some of the abscesses of the liver or about the kidney, and a few cases of appendicitis.

2. *The most virulent* and overwhelming *infections* are apt *not* to be *accompanied by leucocytosis*. Thus, for example, the most virulent cases of pneumonia, diphtheria, or general peritonitis often run their course without leucocytosis.

Lymphocytosis.

Only in two diseases does well-marked lymphocytosis occur: 1. Lymphatic leukæmia. 2. Whooping-cough and its complications (many cases).

Occasionally lymphocytosis occurs in rickets, hereditary syphilis, and anything that produces debility in children. Lymphocytosis is of value chiefly in the differentiation of lymphatic leukæmia from other causes of glandular enlargement.

Eosinophilia.

The eosinophiles are increased chiefly in:

1. Bronchial asthma.

2. Chronic skin diseases.

3. Diseases due to animal parasites (trichiniasis, uncinariasis, filariasis, hydatid disease, Bilharzia disease, trypanosomiasis, and with most of the intestinal worms).

4. Myelogenous leukæmia.

There seems to be also some vague connection between eosinophilia and diseases of the female genital tract (except cancer and fibromyoma of the uterus).

Leukæmia.

Two forms are distinguished, though the distinction is chiefly a clinical one: (*a*) Myelogenous and (*b*) lymphatic.

1. *Myelogenous Leukæmia.*

The leucocytes are usually about 250,000 per cubic millimetre when the case is first seen, but often run much higher, and sometimes lower. There is no anæmia in the earliest stages; later moderate secondary anæmia develops.

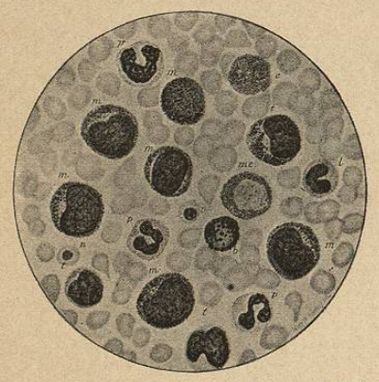

Fig. 216.—Myelogenous Leukæmia. *m*, Myelocytes; *p*, polynuclear; *b*, mast cell; *n*, normoblast.

The differential count shows an extraordinary *variety of types*, including many not seen in normal blood (see Fig. 216). The *majority* of the leucocytes are *polynuclears*, but many of these are atypical in size or in the shape of their nucleus. From 20 to 40 per cent of the leucocytes are *myelocytes* (or mononuclear neutrophiles), the "infantile" form of the polynuclear cell. *Lymphocytes* are absolutely normal or increased, but their percentage is low, on account of the greater increase of the other forms. *Eosinophiles* are absolutely much increased, though the percentage is not much above normal. *Mast cells* are more numerous than in any other disease (1 to 12 per cent, out of an enormous total increase). *Normoblasts* are usually very numerous; megaloblasts scanty.

Under the influence of intercurrent infections or after *x*-ray treatment the blood may return to normal.

2. *Lymphatic Leukæmia.*

The total increase of leucocytes is usually much less than in the other type of leukæmia—40,000 or 80,000—or less in average cases. The differential count shows an overwhelming proportion of lymphocytes—90 to 99.9 per cent as a rule. In the acute forms of the disease the large lymphocytes predominate; in chronic cases the small forms.

The blood-film is *monotonous* in contrast with the wonderful variety seen in myelogenous leukæmia (see Fig. 213, *b*).

V. The Widal Reaction.

(*a*) *Technique.* Among the numerous agglutinative reactions between the serum of a given disease and the micro-organism producing that disease, only one has yet attained wide use in clinical medicine, viz., the so-called Widal reaction in typhoid fever.

There are many ways of performing this reaction, but in my opinion the following is the best:

Measure out in two small test tubes ten drops and fifty drops respectively of a highly motile twelve- to twenty-four-hour bouillon culture of typhoid bacilli, in which the bacilli have no tendency to adhere spontaneously to each other. Carry these tubes and a microscope to the bedside, puncture the patient's ear as usual, and draw a little blood into a medicine-dropper of the same size as that used in measuring out the typhoid culture. Expel one drop of blood into each of the tubes containing typhoid culture, and examine a drop of each mixture between a slide and cover glass with a high-power dry lens. If within fifteen minutes clumping has taken place in the 1:10 mixture, or if within one hour clumping has taken place in the 1:50 mixture, the reaction may be considered positive. By clumping I mean an agglutination of the bacilli into large groups and the complete or nearly complete cessation of motility.

If it is inconvenient to carry the culture and the microscope to the bedside, ten or twenty drops of blood may be milked out of the ear and collected in a test tube (a three-inch test tube of small cali-

bre is best). After clotting has taken place, if the edges of the clot are separated from the glass with a needle or a wire, a few drops of serum will exude, and this serum can be mixed with the bouillon culture in the manner already described.

Less reliable, in my opinion, is the use of blood dried upon glass or glazed paper in large drops and subsequently dissolved in the culture itself.

(*b*) *Interpretation.* A positive reaction occurs at some period in the course of ninety-five per cent of all cases of typhoid fever, but the proportion of cases in which the reaction occurs early enough to be of diagnostic value varies greatly in different epidemics. In most epidemics about two-thirds of the cases show a positive Widal reaction by the time the patient is sick enough to consult a physician. The reaction may be absent one day and present on the next, and varies greatly in intensity in different cases and at different times with the same case.

VI. Blood Parasites.

1. The Malarial Parasite (see Plates IV. and V.).

In films stained as above directed the malarial parasite appears blue against the pink background of the corpuscle. A crimson-stained dot should appear in some portion of the blue-stained organism; the protoplasm of the red corpuscle around it is often studded with pink dots.

The stained specimen is preferable to the fresh blood in the search for malarial parasites, for the young, ring-shaped, or "hyaline" forms often escape notice altogether in fresh specimens.

Tertian organisms are distinguished from the æstivo-autumnal variety by the following tests:

(*a*) Tertian parasites make the corpuscle containing them larger than its uninfected neighbors.

(*b*) Segmenting forms never occur in the peripheral blood of æstivo-autumnal fevers.

(*c*) "*Crescents*" (see Plate V.) never occur except in æstivo-autumnal fevers.

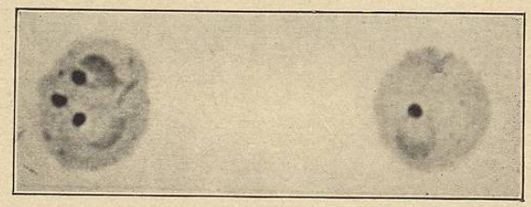

FIG. 1.—Young Tertian Parasites. (Stained with Wright's modification of Leishman's stain.)

FIG. 2.—Mature Tertian Parasites. (Eosin and methylene blue.)

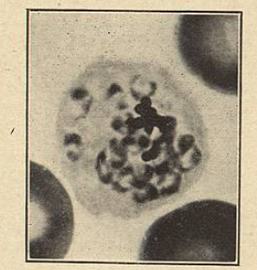

FIG. 3.—Segmenting Tertian Parasites. (Eosin and methylene blue.)

2. The Trypanosoma.

In Central Africa (and presumably in other tropical countries) the blood of many persons is found to contain the organism shown in Fig. 217, which has long been known as a parasite of the blood of horses and of many of the lower animals. Human trypanosomi-

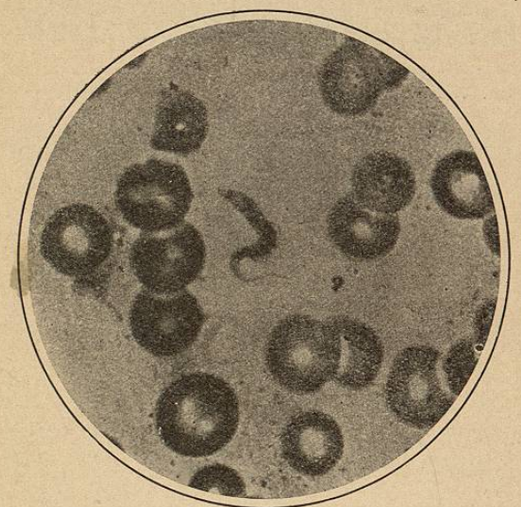

FIG. 217.—Trypanosoma in Human Blood. (By permission of Dr. J. Everett Dutton and the London *Lancet*.)

asis—a chronic, debilitating malady—becomes "sleeping sickness" when the trypanosoma enters the cerebrospinal canal.

3. Filariasis.

In the blood of many inhabitants of tropical countries there is found (with or without symptoms) the parasite shown in Fig. 218. The species most often found is present in the peripheral blood only

at night; hence the blood should be examined after 8 P.M. A fresh

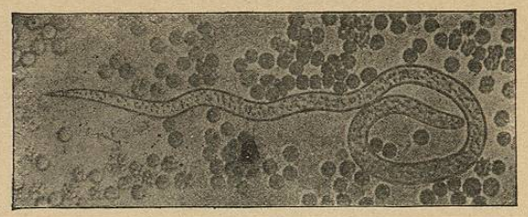

FIG. 218.—The Filaria Sanguinis Hominis. The head, curled up, is seen to the right of the cut, the tail at the left. Instantaneous photomicrograph. Four hundred diameters magnification.

drop is spread between slide and cover and examined with a low-power lens (No. 5 objective Leitz).

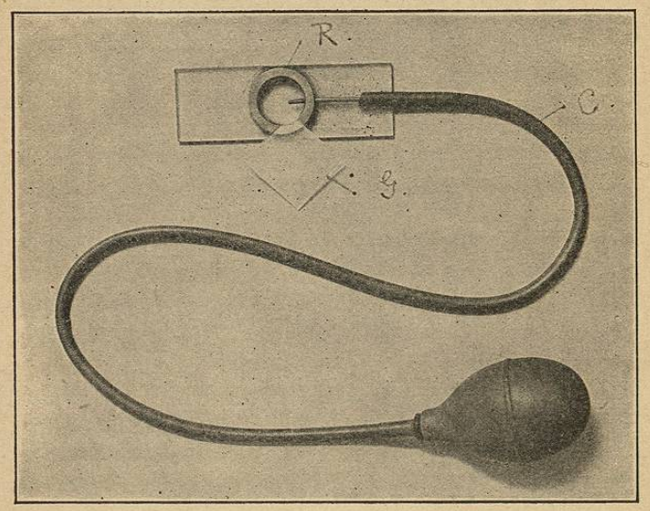

FIG. 219.—Pratt's Modification of the Brodie-Russell Coagulometer. *R*, Brass ring soldered to glass slide; *G*, cover glass; a blood drop on the under side of this, when in place on the brass ring, is close to the point of the hollow metal needle which forms the extremity of the inflation tube, *C*.

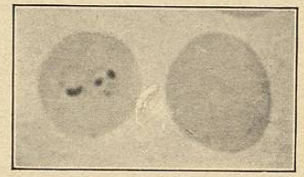

FIG. 1.—Two Young Æstivo-autumnal Parasites. (Wright's modification of Leishman's stain.)

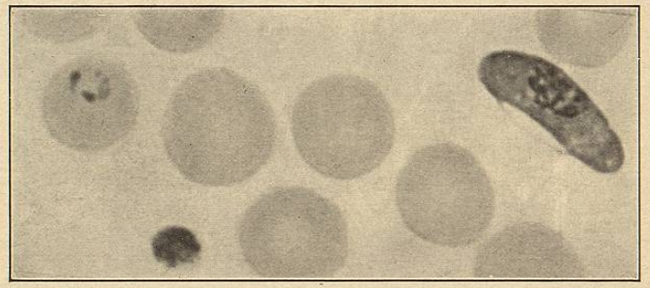

FIG. 2.—Æstivo-autumnal Parasites. Ring body at the left; crescent at the right. Stained like Fig. 1.

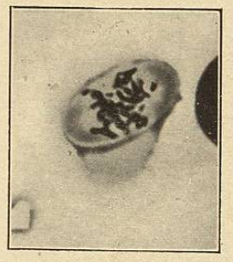

FIG. 3.—Ovoid in Æstivo-autumnal Malaria.

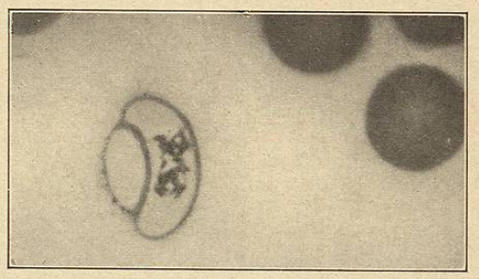

FIG. 4.—Crescent in Æstivo-autumnal Malaria.

VII. Estimation of Coagulation Time.

The Brodie-Russell instrument, as modified by Pratt[1] (see Fig. 219), is, in my opinion, by far the best. To use the instrument, we put a drop of water on the slide inside the metal ring (*R*). Smear this ring with vaseline. Put a drop of blood on the under side of the cover glass and press the latter down into the vaseline, so that the blood drop comes in the middle of the metal ring. Then watch it with a low power of the microscope; at intervals of one minute a current of air is brought into contact with the drop by means of a rubber tube and bulb, *C*. As soon as coagulation has taken place, the impact of this current of air ceases to make the corpuscles fly about.

Normally, coagulation occurs under these conditions in from three to eight minutes; anything outside these limits is to be considered pathological.

The estimation of coagulation time seems to be of some value to surgeons in relation to the question of operation in cases of hemorrhagic tendency (purpura, jaundice, and various liver diseases).

[1] Pratt: Journal of Medical Research, November, 1903. The instrument costs 75 cents.