often the physician sees them in their early stage. What do we find has been done with such? In the great majority the physician has made a diagnosis either of rheumatism or sprain, and proceeded accordingly. Many of these cases have been diagnosed later as simple abscess, septicemia, pyemia, septic thrombosis, neuralgia, typhoid, meningitis or scurvy. In all the available histories of this common, easily recognizable and curable disease, it is most rare to find a case in which the physician has promptly made a correct diagnosis and done the one best thing possible for the patient. In a surgical experience extending over twenty-five years, I have yet to see such a case. Most commonly they come to the surgeon after the damage has been done and necrosis of bone, metastatic abscesses and infective endocarditis have developed.

Here are three illustrative cases at present under treatment, which are cited to show the physician's responsibility and how it is being met.

CASE 1.—Boy, aged 13. Suddenly seized with pain just above ankle; doctor summoned and diagnosis of rheumatism made. Temperature ranged between 104 and 105 every day for weeks. The boy was under medical treatment for three months; the leg was swollen; secondary deposits rapidly appeared in the femur, opposite tibia, and bones of the hand and foot. Septic endocarditis next developed. Delirium was present much of the time for two months, as a result of the profound sepsis. Casts and albumin appeared in the urine. During the medical treatment the boy lay with the infected parts swathed in cotton and oil of wintergreen, with an ice bag on his head for the delirium, and an ice bag over the heart. He took during that period 970 grains of sodium salicylate, 885 grains of potassium iodid, 474 minims of digalen, 360 minims of tincture of digitalis, 285 grains of aspirin, 29 drams of Basham's mixture, 3,780 minims of syrup of ferrous iodid, 1¼ gallons of cod-liver oil, to say nothing of strychnin, iron, quinin, benzoic acid, spartein, sodium bromid, veronal, pilocarpin and sweet spirits of niter. Six different injections of vaccine were given. At the end of fourteen weeks of treatment for rheumatism what remained of the child was sent to us for surgical treatment. He was literally reeking with sepsis. There were discharging sinuses, abscesses and dead bone; the valves of the heart were seriously damaged; the limbs were distorted and extreme emaciation and prostration were present.

The whole of the shaft of the tibia had to be removed; the other foci of dead bone were extirpated; and the boy after a year of suffering is about to be returned to society, permanently crippled, as the result of a malady which could have been cut short by a simple opening made in the lower end of the tibia when he first came under medical observation.

CASE 2.—Boy, aged 10, taken sick with pain referred to shoulder, which came on rapidly during the night. He seemed very sick and the pain in his arm severe. The next day he was taken to a physician, who made a diagnosis of neuralgia and prescribed liniment for rubbing. This treatment was persisted in for two months, during which time the upper arm at the shoulder became larger and larger. A change of doctors secured a diagnosis of rheumatism, and treatment by passive motion and electricity was carried out for six weeks. Later a needle was introduced into the swelling and pus found. The abscess was incised. This not healing, the boy was sent to the hospital for surgical treatment. The head of the humerus was found necrotic. Its removal left the boy with a stiff shoulder. Now, after nearly a year of invalidism, he is developing a secondary focus of infection in the tibia.

CASE 3.—Boy, aged 12, rapidly developed pain just above the ankle; no swelling or redness; it was regarded as a sprain. The boy continued to be sick with high fever and prostration. On the third day a physician was called, who ordered alcohol applied, but the inflammation continuing, the doctor advised operation. This the parents could not afford. Another doctor was called who said that the boy could be cured without operation. A diagnosis of erysipelas was made and treatment applied accordingly. An abscess pointed and was incised. Vaccines were injected for the septicema. The boy remained very ill. Then a secondary infection developed in the upper part of the tibia. Six weeks after the onset of the disease the boy was brought to the hospital and placed under surgical care. The whole diaphysis of the tibia was found necrotic, and was removed. This boy is crippled for life.

A fourth illustrative case is herewith included.

CASE 4.—Girl, aged 14, had done "sweat shop" work since she was 8 years old; fell in the dark and injured leg; two days later had pain at ankle and felt ill, but went to work. The pain became severe. She fainted in the shop and then went home. Next day had pain at wrist. High fever and delirium were present. Doctor, called on fourth day, made diagnosis of rheumatism and meningitis. Patient never came under surgical care. Died on seventh day.

This is not a discussion of chronic osteomyelitis, nor the tuberculous forms of bone disease, nor what can be done in the way of osteoplastic operations to remedy the resulting defects. The common form of acute infection only is under consideration.

These are but illustrative cases. They are not cited in a spirit of criticism. They are object lessons to all of us. They show the need of vigilance and the necessity for renouncing the old nomenclature, including such terms as "rheumatism," and seeking for the fundamental pathologic conditions underlying every symptom.

To recapitulate: Even in experienced hands the diagnosis of most surgical conditions may be difficult. Many surgical diseases recover without surgery. Some are made worse by surgery. But acute osteomyelitis is most easy of diagnosis from the very beginning. It invariably does badly unless treated surgically. Its treatment is so simple that surgery at its worst cannot do as much harm as the disease. In most surgical procedures skill is the important factor, but in acute osteomyelitis expedition is the one prerequisite for success.

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LEUKOCYTOSIS A DECEPTIVE SIGN IN ABDOMINAL HEMORRHAGES

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The conception of leukocytosis as an indicator of inflammatory conditions in the abdominal cavity should be altered to make an exception of abdominal hemorrhages. This diagnostic point seems to have escaped the attention of all writers with one or two exceptions. A distinction is to be made between the leukocytosis which occurs promptly after intra-abdominal hemorrhages and the posthemorrhagic leukocytosis which sets in after any severe bleeding and is generally considered as a regenerative phenomenon. Most writers on the blood and blood-forming organs maintain that the anemia resulting from hemorrhage acts as a chemical stimulation to the bone marrow and other erythropoietic apparatus.

A review of the works of authorities on the blood shows very little on this subject in a positive way. Numerous writers mention, however, that the presence of a leukocytosis in the differentiation between appendicitis and abdominal hemorrhage speaks for the for-

mer and excludes the latter. DeQuervain[1] makes the observation that an exploding extra-uterine pregnancy may cause a leukocytosis as high as 26,000, even without infection. Hoessli[2] reports three cases from the surgical clinic in Basel, and in a review of the literature up to the time of writing his paper (1914), found no other reference to this diagnostic point. This seeming lack of attention to the value in diagnosis of leukocytosis in intra-abdominal hemorrhage is the reason I wish to record the following case.

The patient, a woman, aged 39, was seen in May, 1914. She was well up to the day of illness, when she was seized with moderately severe abdominal pains, more pronounced on the right side. She was seen shortly after the onset of the pains. This first examination at 8 a. m. revealed slight rigidity of the abdominal wall, but without definitely increased rigidity on the right side.

Palpation of the abdomen was painful, with the greatest area of tenderness approximating the appendiceal region. The temperature was 99 F. and the pulse rate 90. There was slight nausea, but no vomiting. The white blood-cell count at this time was 20,000. None of the symptoms were severe and the condition of the patient did not cause any apprehension at this time. She was seen again at noon of the same day. The pains were not severe, but moderate in intensity and cramp-like. The temperature remained 99 and the pulse rate had increased to 100. The white count was now 22,000. A surgeon was called in consultation and a probable diagnosis of appendicitis made on account of the location of the pain, the abdominal tenderness, and the high leukocytosis. Ruptured extra-uterine pregnancy was discussed and excluded on account of the absence of the external appearance of hemorrhage, the lack of a very rapid pulse and the high white count. The patient had never had children, the previous menses were normal, and there was an entire absence of uterine bleeding between the regular periods. The patient was operated on the same afternoon and showed a ruptured tube with moderately severe, intra-abdominal hemorrhage. She left the operating table in excellent condition and without evidences of marked exsanguination. A white blood-cell count before operation showed a leukocytosis of 18,000. A postoperative pneumonia ensued and caused death the third day after operation.

The three cases which Hoessli reports gave white cell counts of 30,000, 15,000 and 19,000, respectively, before operation. None of these cases showed any other reason for the leukocytosis than the hemorrhage. Inflammatory processes were ruled out by very careful examination. The first question to be raised was the influence of normal pregnancies on the white blood cell count. Recent investigations by Naegeli have shown the absence of leukocytosis in pregnancy, especially in the first months which correspond to the period of extra-uterine bleedings. There are found only "high physiological values," which Naegeli refers to "increased vital processes." A distinct, neutrophilic leukocytosis is found at birth, which is explained by the tissue lesions and the hemorrhage. It is necessary also that a digestive leukocytosis as a factor in the above cases be excluded. Hoessli states that a digestive leukocytosis did not come in consideration in his cases, and in the case reported by the writer the initial count was made before breakfast.

The explanation of this posthemorrhagic leukocytosis was sought by Hoessli in an experimental way. Rabbits were chosen for experimentation with the stated reservation that the results may not be entirely applicable to humans. It was possible to secure constant normal values, after a sufficient number of preliminary counts had been made to determine the daily variations, and also the result of digestion. The average daily counts in rabbits were found to be from six to ten thousand. Variable amounts of blood were then withdrawn from the rabbits and injected into the abdominal cavity or subcutaneously. The amounts of blood withdrawn were calculated to correspond approximately by weight with a hemorrhage of from 400 to 800 gm. in human beings. The animals were not anesthetized or otherwise narcotized, as A. von Lerber[3] has shown that ether influences the blood picture and causes a leukocytosis. Sufficient care and precautions were taken in the controls, so that the results which were obtained could be ascribed in all probability to the hemorrhage. Hoessli conducted his experiments in series to determine various points.

The first series of experiments had for its purpose the determination of the effect of withdrawing blood from animals. The average, final results of this series showed that the number of the white cells decreased for the first six or eight hours. Later, there was some increase in the red cells and also of the neutrophils. The first decrease of the white cells is to be explained by the withdrawal of the blood and by the pouring of tissue juices into the vessels. The result is that of a temporary hydremia. This series of experiments corresponds to the conditions which produce the usual posthemorrhagic leukocytosis.

In the second series, Hoessli took blood from one animal and injected it immediately into the peritoneal cavity of another animal. There was a marked rise of the leukocytes in the first six hours, followed by a drop to normal by the next day. Hoessli ascribes the increase of the white cells to an irritation of the peritoneum and the peritoneal absorption of blood.

The third series of experiments more closely approximated conditions in human intra-abdominal hemorrhage. The blood was withdrawn from the animal and at once injected into the peritoneal cavity of the same animal. Here, likewise, there was a marked rise in the number of white cells during the first six hours, followed by a return to normal the next day.

In a fourth series, Hoessli withdrew blood from the carotids and injected it immediately into the abdominal wall of the same animal. He found that the white cells increased markedly in from nine to twenty-four hours and dropped back to normal by the fourth day.

These experiments will be found to harmonize very well with conditions in actual clinical experience. A sudden hemorrhage from a ruptured tube, an ovarian hemorrhage, and doubtless from other causes also, will cause in a short time a hyperleukocytosis which may reach figures higher than those to be expected in appendicitis. The leukocytosis in intra-abdominal hemorrhage will disappear in from twenty-four to forty-eight hours, but this period happens to cover the exact time in which the patient is first seen and in which there are diagnostic difficulties. In case the hemorrhage has lasted longer or is not seen until late, the white blood cell count will not present anything of value. The diagnosis at this time, however, is usually easy even from a hasty examination. When there has been a severe hemorrhage from which the patient is recovering, there will be found during the period of

1. DeQuervain: Des erreurs de diagnostic dans l'appendicite, Rev. méd. de la Suisse romande, 1913, xxxiii, No. 7 (cited by Hoessli).
2. Hoessli: Leukocytose bei Intraperitonealblutungen, Mitteilungen a. d. Grenzgeb. d. Med. u. Chir., 1914, xxvii, 630.
3. Von Lerber, A.: Ueber die Einwirkung der Aethernarkose auf Blut und Urin, Inaug. Diss., Basel, 1896.

regeneration of new blood cells, the usual and above mentioned phenomenon of posthemorrhagic leukocytosis. The behavior of the white cells after operation is influenced by the anesthesia, and any possible leukocytosis could be due to the narcosis as well as the hemorrhage. It is difficult to give the duration of the leukocytosis after intra-abdominal hemorrhage because the patients are usually operated on as soon as the diagnosis in made and the subsequent counts are influenced as above stated. The morphologic blood picture does not show any change, either in the differential formula or in the sense of Arneth. The short course of the hemorrhage before operation is hardly sufficient for such a change in the blood picture.

It follows from these observations that when the clinical signs of a certain condition in question might be either from appendicitis or other inflammatory condition on the one hand, and intra-abdominal hemorrhage on the other, the white blood cell count is not to be relied on in the differential diagnosis. If the patient shows signs favoring hemorrhage and against inflammatory conditions, such as absence or near absence of fever and a quiet pulse, a high white count would be of real value in making the diagnosis.

SUMMARY

1. A leukocytosis should not be relied on as a differential point when the clinical signs demand the differentiation of appendicitis or other inflammatory trouble in the abdomen, and an intra-abdominal hemorrhage.

2. Leukocytosis due to intra-abdominal hemorrhage is to be distinguished from the posthemorrhagic leukocytosis which follows any severe bleeding.

3. Leukocytosis from intra-abdominal hemorrhage comes on within twenty-four hours and lasts until the second day.

4. The leukocytosis is ascribed to an irritation of the blood-forming organs by the absorbed constituents of the blood. The peritoneum may be a factor in the formation of white cells.

5. The morphologic blood picture is not changed.

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THE NORMAL DIFFERENTIAL LEUKOCYTE COUNT

A PROPOSED CLASSIFICATION OF THE WHITE BLOOD CELLS

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A cursory glance over the literature dealing with problems wherein differential blood counting is a feature, shows a lack of unanimity of nomenclature which vitiates much of the work. It is next to impossible to tell what one author means when he gives only four groups of white blood cells while it is equally impossible to place the cells when another author gives eight or nine groups. If differential counts are to be of any value in diagnosis (and I, for one, firmly believe that the value is underestimated), then there must be some uniform and simple classification which will fit a very large percentage of cases.

Some years have elapsed since Ehrlich's epoch-making discovery of the differences in leukocytes, and during those years some advances have been made. Chief among these was the introduction of the eosin-methylene blue stains in polychrome combination first proposed by Romanowsky for the staining of the malarial parasite. The use of this stain in its various modifications has done more to advance the science of hematology than any other one method.

Those who hold that the Wright or Hastings stain is better than the Ehrlich are still looked on as hopeless iconoclasts. Just why there is this apparent prejudice in some quarters against the polychrome methylene blue stain is difficult to understand. Possibly faulty technic has been responsible for poor specimens and poor results. Cabot[1] puts the facts well in the following words: "This stain (Wright's) brings out all that Ehrlich's method does and besides this stains the blood plates, the granules of the mast-cells, the chromatin of malarial parasites and the basophilic granules in abnormal red cells—all points of value. (To this might be added that it shows beautifully all the so-called transitional cells but poorly shown by Ehrlich's method.) The only weak point of the Romanowsky stains is the deceptive resemblance between certain megaloblasts, certain lymphocytes and certain myelocytes. In perhaps 1 case in 100 this troubles a beginner, in perhaps 1 in 1,000 it troubles an expert; but in no case does this difficulty affect the essentials—the diagnosis, prognosis or treatment of the case."

In a recent book on "Bedside Hematology"[2] occurs this truly astounding and grossly inaccurate statement: "The transitional leukocyte is similar to the polymorph;—in health they are usually between 2 and 5 per cent."

Even so excellent a book as Emerson's on "Clinical Diagnosis" in the last (third) edition gives much space to the elaborate classification of Ehrlich (now of historical interest only), and gives his classification as a working basis for differential counting. This has been shown by Bunting[3] and others to be inaccurate, at least for our population. In describing the cells for differential purposes Emerson[4] says, "By small mononuclear is meant any non-granular cell smaller than a polymorphonuclear neutrophil. This group would include, therefore, all lymphocytes and the small transitionals and transparents of Uskov. As large mononuclears are classified any non-granular cells larger than a polymorphonuclear neutrophil with a round or oval nucleus, any cell within the same size limits, but with an indented nucleus, is called a transitional. The polymorphonuclears, both neutrophils and eosinophils, are clear enough. As a *Mastzell* is counted any polymorphonuclear cell without granules (Ehrlich's stain), or with blue granules if methylene blue is used." Imagine a student trying to classify the non-granular cells from such an enigmatic description.

In a recent article, Staines, James and Rosenberg[5] have classified the leukocytes into polymorphonuclears, very small lymphocytes, larger lymphocytes, large mononuclears, transitionals, and have added all the mononuclears together in figuring a lymphocyte increase. This is manifestly wrong, as these cells are not all the same type nor have they all the same significance in diagnosis.

1. Cabot, R. C.: Modern Clinical Medicine, 1906, Ed. note, p. 296.
2. Ward, G. R.: Bedside Hematology, Philadelphia, W. B. Saunders Company, 1914, p. 36.
3. Bunting, C. H.: The Normal Differential Leukocyte Count, Am. Jour. Med. Sc., 1911, cxlii, 698.
4. Emerson, C. P.: Clinical Diagnosis, Philadelphia, J. B. Lippincott Company, Ed. 3, 1914.
5. Staines, M. E.; James, T. L., and Rosenberg, C.: Lymphocyte Increase and Altitude, Arch. Int. Med., Sept. 15, 1914, p. 376.