

a muscle memory. All muscular action not directly reflex is the product of such memories; automatic action is connected with memories which impinge little if at all on consciousness; in fact, much of it is so rapid as to run before consciousness. Volitional acts are dependent on muscle memories combined with or added to memories of sense perception.

The way in which the muscle sense contributes to voluntary acts has been well illustrated by Meynert. A finger is approached to the eye of a new-born child. A memory is stored up of the visual impression on the retina, of the tactile and painful impression when the finger touches the cornea, of the muscular movement which results by reflex. After this has been repeated a number of times, the sight of the approaching finger awakens the memory of the pain and the eye is voluntarily closed by the intervention of muscle memory.

The weight of an object is estimated by comparison of the muscle percept consequent on lifting it, with the muscle memories of other objects similarly lifted. The actions in so testing an object are characteristic.

The position of the limbs is partly gauged by the exertion put forth in maintaining them in that position. The size of objects may be estimated by the position of the grasping hand and fingers, this being made possible by the muscular sense. The amount of eye strain in accommodating and converging for near objects affects one's estimate of their distance and size. As small near objects may subtend the same projection angle on the retina as do large distant ones, it would be impossible to estimate their comparative distance and size if it were not for memories of similar things seen before, with the memories of the effort of the eye muscles in accommodating and converging for them. As distant objects require practically no accommodation and convergence, one's estimate of their size is governed by any opinion which may be formed in regard to the distance and *vice versa*. Very distant objects, like the moon, are apt to be judged in relation with the objects seen at a small angular distance from them—for instance, the objects on the horizon. When the head is moved the eye muscles by their action tend to keep the eyes directed toward the same object. The muscle percepts are in this case changed, and give the impression not of movement of the eyeballs, but of the shifting positions of the head. When body movements are violent, as on a ship or in a swing, muscular sensations may be so acute as to cause nausea and vomiting.

Muscular sensibility is too complex to admit of close localization in the brain. The motor centres and parietal centres for common sensibility are probably the ones chiefly concerned.

Isolated disturbances of muscular sensibility are not so common as would seem likely from the importance of the muscular sense. This is probably due to the fact, just pointed out, that it is complex in action and scattered in various parts of the nervous system. A severe and widespread lesion causes paralysis or general anaesthesia or both, either of which masks the loss of muscular sensibility. Isolated loss of muscle sense usually shows itself in one of two ways: as loss of power to appreciate the position of the limbs, and as astereognosis, or failure to estimate the size, shape, and weight of objects. The former is more marked in the legs and is seen in some cases of locomotor ataxia and multiple sclerosis; the latter is more often found in the arms and is a rare accompaniment of organic brain disease. A curious and rare muscular anaesthesia occurs in the so-called megalopsia and micropsia. These are usually transient symptoms, occurring suddenly in the early stages of tabes dorsalis and other scleroses and in hysteria. Objects seem unusually large or unusually small from a failure of muscular sense in the ocular muscles.

To test the integrity of the muscle sense the limbs should be given various positions, the patient's eyes being closed, and he should be made to guess the degree of their flexion or extension. He should be made to estimate the weight of objects held in the hand; he should

name and describe the shape and size of objects held with the eyes closed.

Disorders of visceral sensibility have been less studied and less importance has been attached to them than to those of the skin, probably because of their vagueness and often their slight localizing value. They are, however, from the psychologic and still more from the medical point of view, of much greater importance.

Visceral sensations may be classed, so far as our present knowledge goes, under the heads of local pain; referred pains (already described); more general visceral sensations on the border between pain and emotion, including hunger, thirst, fatigue, sexual desire, nausea, dizziness, and nervousness; emotions, either as direct visceral sensations, or as perceptions of visceral change from psychic causes, including fear, shame, anger, joy, exaltation, and depression or psychic pain.

Local pain in visceral disease is usually dull even when very severe; it is, unlike referred pain, not associated with psychic or emotional change. Tenderness is elicited by deep pressure and may be masked by the referred tenderness of superjacent skin. It may take on varying characters according to its location; when it is abdominal, the patient has a tendency to draw up the knees, with the apparent purpose of diminishing tension in the abdominal cavity.

Hunger is the desire for food, which increases with abstinence, but not indefinitely. It is born in large part from the physical state of the stomach, as indicated by the fact of its existence as a dyspeptic symptom. Too free secretion of hydrochloric acid or the presence of an excess of organic acids, either ingested or formed in the stomach by fermentation, may cause craving hunger with consequent over-eating. Spices and alcoholic stimulants have the same effect. The need of the body tissues in general for nourishment causes a feeling of weariness, not of hunger; the appetite is sated before an appreciable amount of ingested food has reached the more distant tissues.

Thirst is a sensation caused by the drying of the tissues. The mucous membranes of the mouth, tongue, and throat are the parts most affected. The feeling may be excited by other irritants.

Hunger and thirst are occasional symptoms of organic brain disease. This fact does not prove the existence of a hunger centre or a thirst centre in the brain any more than running from danger proves the existence of a fear centre. The various mucous membranes have a cortical representation, and excitation of these sensory centres by disease has the same psychic result as that which follows the application of a stimulus to the membranes themselves.

Extreme hunger and, still more, extreme thirst may have an overwhelming effect on the nervous system. Sufferers from thirst in the dry hot air of the desert are maddened by the agony of the drying tissues, and die in delirium within a few hours, practically the victims of shock. Long-continued hunger commonly evokes dreams and hallucinations of banquets.

Fatigue is a toxic symptom. Tired muscles are overcharged with sarcolactic acid, and brain work and other expenditure of nervous energy result in the accumulation of oxidized waste products; in either case the result is a set of sensory signals, consisting of heavy aching pains in the muscles, soreness in the eyeballs, and, in the case of brain fatigue, a tired feeling, not in the brain itself but in the cerebral or cranial blood-vessels, possibly also in the meninges.

Of more interest is the pseudo-fatigue of neurasthenia and of visceral disease. The same tissues are affected by the poisons formed as the result of fatigue and by stomach indigestion and intestinal putrefaction, by defective liver action, and by poisons retained on account of imperfect elimination by diseased kidneys. The result is the same, viz., heaviness in the limbs, aching of the eyes, throbbing and dulness in the head. These may be spontaneous or may ensue on an amount of exertion too slight appreciably to affect a normal person. Such fatigue is

spurious and may sometimes be overcome by exercise if the underlying disease is benefited by it.

Great fatigue is the apparent cause of many of the functional and even some organic nervous diseases. Such disorders arise from fatigue in three ways: as the result of the acuteness of the feeling; by the overwhelming of the nervous structures by poisons produced from the overworked tissues; but mainly by the exhaustion of the nerve cells by severe and long-continued action. Of diseases produced in the two last-named ways we are not speaking, but only of those set up by fatigue as a sensation. In the latter sense fatigue is on the same footing with the emotions, and, being ordinarily a weak sensation, it is of not great importance in causing disease.

Of much more import as sensation is sexual desire. It is, even apart from performance, accompanied by vaso-motor changes which, when excessive or perverted, give rise to widespread disturbances of the vascular system. The sexual organs proper are not alone concerned in the sexual act. Desire is influenced by complex considerations in which beauty and even intellectual attractions play a part; the phenomena of blushing, crethism of the lips and breasts, and the mysterious part played by the thyroid gland in sexual life all contribute to involve widely different functions in sensory sexual disorders.

Sexual excitement, especially when accompanied by masturbation about the age of puberty, is likely to be attended with disastrous results. It is not always easy to trace the relationship of cause and effect between sexual excitement and the psychoses. Either may be the cause, or they may intensify each other. They usually coexist with degenerative stigmata. *Dementia praecox*, chorea, habit spasms, exophthalmic goitre, and even epileptiform attacks may follow in the train of sexual excitement in the young apparently as the result of the effect on the sensorium and of the accompanying vaso-motor derangement.

Nausea and dizziness are symptoms often associated with each other and with temporal pain. Nausea is not a stomach sensation, but is the sensation or the sensory and motor memory of the act of vomiting, together with that of the flow of saliva and trembling of the lips which precede it. With this there is often the sensation known as dizziness, coming from the semicircular canals, with possibly fullness of the cranial blood-vessels and throbbing in the temples. Some of these phenomena may be absent, according to the cause of the nausea or of the dizziness. Pain in the temples, which so often accompanies nausea, is usually the referred pain of liver or stomach disease, of disease of the cerebrium or cerebellum, or of disease of the eyes or teeth.

One of the most important feelings on the border line between emotion and sensation is nervousness. This term should be dissociated from hysterical and neurasthenic symptoms in general and limited to the pathologic feeling of unrest consequent on physical or psychic stimuli, and leading, or tending to lead, to either purposive or spasmodic movements of the voluntary muscles. The predisposition to nervousness varies much in different people. When not produced by psychic causes it is present in consciousness usually as a distinct feeling from the arms or legs, although it may be occasionally referred to the head, back, or other parts of the body. The lesion may be a local irritant, a suppurating wound, a felon, or compression of a nerve trunk among other alterations, or the abnormal feeling may be referred from a viscus to the limbs or trunk as ordinary pains are referred. This referred nervousness is common and is remarkable at times for its intensity. Patients suffering from an overloaded sigmoid flexure and rectum may suffer torments from nervousness in the legs and feet as do patients suffering from uterine or ovarian disease; intestinal putrefaction sometimes causes a generalized nervous feeling that keeps the patient walking the floor day and night in agony.

Of the causes of nervousness, aside from the predisposition which is always to be reckoned with, it makes little difference whether they are psychic, irritative, or

toxic, so far as the symptoms are concerned. Any one of these causes is more effective in the presence of either of the other two, and, as with ordinary pains from whatever cause, the amount of nervousness felt is much modified by diversion and increased by attention. Nervousness is no more under the direct control of the will than is ordinary pain, but like the latter it may be more or less controlled by suggestion or affirmation. While the motor effects of nervousness are in some ways like those of exaltation of acute mania, the underlying emotional content is entirely different, being in the one case disagreeable, in the other pleasant. Nervousness is, in fact, often associated with profound depression, especially when both states of feeling arise from visceral disease.

The sensations which have just been described have an obvious emotional content; they hold a position about midway between feeling and what has been considered pure emotion; they may be set up by purely physical or by purely psychic causes, and there is no peculiarity in the resulting feeling to mark its origin. The fact that impressions of touch and pain may have a purely psychic, and true emotion a purely physical cause, justifies the inclusion of the three kinds of sensation in the one category. The emotions of depression, of exaltation, fear, joy and the like, have the peculiarity in common that they are projected into the psychic environment. The tendency to find an object for a feeling of anger, and to attribute depression to a misfortune great or small, connects these emotions definitely with the realm of thought. That they really consist of the normal individual sensations which come from the viscera but which are not recognized as such, has already been pointed out. This fact puts them among the most important sensory manifestations from the medical point of view.

The study of emotion from visceral disease is attended with certain difficulties. Chief among these is the fact that disease of any one viscus, and even the same disease of a particular organ, so far from always causing the same feeling, may give rise to the most varied play of emotions. Much, however, may be learned by observations of such cases, and reasoning back from psychic symptoms to the disease is often possible even in the absence of definite physical indications.

The lighter grades of emotional change may be called moods. These moods are of frequent occurrence in otherwise normal people, and apparently depend on either autotoxic or meteorologic influences, or both. The referred pains of organic visceral disease are associated with well-defined changes of mood which are coincident in time with a sudden increase in the amount or intensity of the pain. These moods are depression, exaltation, suspicion, irritability, and with them there may be hallucinations of sight, hearing, and smell. The patient assigns no cause for his depression; he has no delusions with his hallucinations; although his suspicions attach themselves to his friends and those about him, they are readily removed by simple denial of their truth. The moods have practically only an emotional content; they come as suddenly as the pains, last for a few minutes or a few hours, and leave equally suddenly. They are, according to Head, singularly little affected by outside circumstances, by cheerful society, music, and so on. Pains below the mid-dorsal segment are likely to be associated with depression; above this, with exaltation.

A more profound and lasting change in the emotional life is wrought by toxins of various kinds. An instance of this kind is the well-known irritability of a masked attack of gout. Depression from auto-intoxication may be so intense as to overshadow all other symptoms. Typical instances are furnished by patients who, following an indiscretion in diet, have a mass of sour material retained in the stomach. They may have with this marked but not intolerable depression, which is promptly relieved on emptying the stomach with a tube or by vomiting. Much more serious is the depression associated with intestinal putrefaction, following acute diarrhoea in patients in whom the poisons have been allowed to accumulate in the intestinal canal, and in putrefaction

from other causes. In these patients depression is extreme, often not associated with delusions except possibly the pardonable idea that they are going insane; there may be with the depression a nervousness so great that the patient presents a typical picture of *melancholia agitata*, walking the floor in agony. Such cases are acute. A deficiency of the hydrochloric acid of the gastric juice may cause a mild chronic depression, simple, and easily improved or cured by appropriate treatment.

In all of these cases it is not known where or how the poisons generated in the alimentary tract have their effect. As the emotions are sensations from the viscera, and as the sensory nerve endings of the affected viscera are bathed in the poisons, it is not a remote possibility that their action may be a local one and not due to their being absorbed and in this manner producing an effect on the sensory centre. The prompt action of local remedies, stomach washings, purgation and enemata, favors this view.

The prevailing emotion in consumption is moderate exaltation. This may be heightened by the stimulus of an attack of referred pain, especially that due to disease of the upper pulmonary lobe; disease of the lower lobes is likely to cause referred pain with attacks of depression.

Uterine and ovarian disease is especially prolific of emotions, either simple depression, to which in extreme cases delusions may be added, or exaltation amounting in some cases to mania. The most deceptive forms of these affections are those in which there are no accompanying symptoms, sensory or otherwise, calling the patient's attention to the affected organs. The difficulty is further increased by the fact that digestive disturbances may make their appearance and mask the other symptoms. The difficulty of distinguishing between these cases and cases of insanity with coincident visceral lesions may be considerable, as these patients possess many or all of the symptoms of insanity, and yet it is not very important to make the distinction between the two classes of cases. Organic defects should be remedied, if possible, even in the insane, and in addition it may be fairly doubted whether even in cases of hopeless insanity, organic visceral disease may not often be the determining cause of the mental breakdown.

The pelvic organs sag and pull on their attachments and as a result there are sent out to other parts of the nervous system signals of distress which take not only the form of moods, but of pains in the back and head, vasomotor disturbances, flushing, fainting, palpitation and the like. In the same way sagging abdominal organs set up all these classes of symptoms. In especial a prolapsed kidney is often responsible for attacks of dizziness, headaches, flushings, and faintness which are often attributed to anything but their real cause.

One of the most striking emotional changes from visceral disease is the fear suffered by patients afflicted with angina pectoris. A good deal of anxiety is felt by many patients who suffer from palpitation, over and above what would be warranted by the nature of their complaint. The fear in angina pectoris is inherent and does not proceed from a knowledge of the danger incident to the disease. It is a signal to the brain direct.

Little more has been attempted in the present article than an outline of the subject of sensory disorders, with the idea, especially, of tracing the complex relations which exist between the sensory system of the skin and that of the viscera. Consciousness is not, in this connection, of prime importance. It is a mysterious light that shimmers on a few of the actions and reactions of the nervous system; in considering the part played in disease by the sensory system, it is of especial importance to recognize the fact that sensory phenomena may and often do take place without its intervention.

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SEPTICÆMIA AND PYÆMIA.—HISTORICAL MEMORANDA.—A constitutional disturbance accompanying putrefaction in wounds, particularly fractures and injuries of the skull, was described by Hippocrates. In the

Middle Ages Ambrose Paré and Paracelsus, both noted metastases following certain injuries in which suppuration occurred. In 1720 Boerhaave first enunciated the doctrine that the condition was due to pus in the blood. His contemporaries, Morgagni and Petit, also tried to prove that metastatic abscesses were brought about by penetration of pus into the blood. In 1774 John Hunter recognized phlebitis as an intermediate factor in producing metastatic abscess, but the exact relation of the two was not clearly defined. In the early part of the nineteenth century (1808-22) Gaspard initiated the experimental method of studying septicæmia by injecting putrefying materials into the veins of animals. Later, the investigations of Virchow, Billroth, O. Weber, Koch, and others formed the basis upon which Gussenbauer built the following definitions: "By *putrid infection or septicæmia* we mean that general disease of the body which results from the introduction into the circulation of the products of decomposition, and which is characterized by definite changes in the blood, a typical succession of inflammatory processes, and a continuous fever together with peculiar nervous symptoms and critical discharges." *Pyæmia* is defined by him as "a general infective disease which arises from the entrance into the blood of the constituents of infected pus, and is distinguished from other septic infective diseases by the development of multiple pus foci in different organs, and an intermittent fever."

Since Gussenbauer formulated these definitions, extensive investigations have been made from both a bacteriological and a pathological standpoint. From the studies of Ogston, Rosenbach, Doyen, von Eiselsberg, and others the conclusion is drawn that the general systemic disease known as septicæmia depends upon the introduction of pathogenic, especially pyogenic micro-organisms into the general circulation. Marmorek further limits the definition of septic intoxications, infections (mycoses), and pyæmia to those general systemic diseases caused by the activity of the streptococcus pyogenes and staphylococcus aureus, for, he claims, that these are the only two micro-organisms which can cause all the various phases of septicæmia, from a carbuncle to the most severe pyæmia. He excludes as etiological factors such agents as bacterium coli, pneumococci, etc., which he claims cannot cause furunculosis, lymphangitis, and lymphadenitis. However, this cannot be accepted by the clinician, for not only are his premises and therefore his conclusions incorrect, but in addition there are so many forms of septic intoxication and infection presented to the observer, in which the etiological factor is other than the streptococcus pyogenes and staphylococcus aureus, that it is impossible to limit the disease to those agents alone.

CLASSIFICATION.—Konrad Brunner ("Erfahrungen und Studien über Wundinfektion und Wundbehandlung, III. Theil. Die Begriffe Pyämie und Septhämie im Lichte der bakteriologischen Forschungsergebnisse") classifies the disease from an etiological and symptomatological standpoint. Slightly modified by the present writer, it is as follows:

I. *Septicæmia Not due to Bacterial Activity.*—A general disease brought about through necrotic or putrefactive processes.

II. *Systemic Diseases due to Pyogenic Microbes; Pyæmia, Acute or Chronic.*—General infections in which metastases make their clinical appearance, due generally to staphylococcus, streptococcus, pneumococcus, or to proteus, pyocyanus, coli, or typhoid bacilli; the fundamental principle being that the signs and symptoms of metastases break in upon the general symptoms.

2. *Pyotoxinæmia, Toxinæmia, Toxæmia.*—A general disease without the clinical signs of metastases, but with the symptoms of a constitutional intoxication, brought about by all kinds of bacteria.

III. *Pyosepticæmia or Septicæmia.*—A general disease in which the products of pyogenic bacterial activity combine with those of decomposition to cause the symptoms. For a fuller discussion of the subject of classi-

fication the reader is referred to the above work by Brunner.

ETIOLOGY.—So far as the classification is concerned, the bacteria, in all but the first form of the disease, play the chief rôle. There is *no specific micro-organism*, but a whole series of them as etiological factors. The same micro-organism acts differently under different conditions. There are many factors which tend to change or govern the result of their activity. The point of infection, the character of the media into which they penetrate, the personal factor, the microbic association, the varying virulence of the micro-organisms themselves, the lowered vitality of the parts—all these influence the course of the infection.

The mode of entrance of bacteria into the system has been the subject of much investigation. In some cases they are, through the medium of a seemingly slight wound, introduced rapidly into the circulation, presumably being taken up by the capillaries. In the great majority of the cases, however, the bacteria first gain access to the lymph spaces and are carried through the lymph channels to the blood. Starting from a localized pus focus the bacterium first has to pass the barrier of granulation tissue, which has been thrown up by the tissue as a bulwark against the bacterial invasion. That healthy granulation tissue does act as a successful barrier has been conclusively demonstrated by Noetzel in his experiments on sheep. When these granulations, however, are not sufficiently developed, the micro-organisms pass through them and enter the lymph spaces. By the lymph they are carried to the lymph nodes, which present the next barrier against their invasion. In their course to the nodes varying degrees of lymphangitis may be set up. The nodes increase in size and in some way, as yet not definitely known, they retard the growth of the bacteria and in many cases limit their further growth. Dr. Mallory, of the Harvard Medical School, has lately demonstrated that in the periphery of the node there sometimes occurs a proliferation of the endothelial cells lining the trabeculae which traverse the lymph spaces. These take upon themselves phagocytic properties and enclose not only the bacteria but also leucocytes themselves, which may already have ingested some bacteria and in addition large numbers of red blood cells. In the nodes the pyogenic bacteria often bring about suppurative processes and, destroying these organs, pass on and are emptied into the blood stream. More often the resistance of the nodes is overcome without producing suppuration. Upon reaching the blood the bacteria are again attacked. Through the production of so-called *sozins* and *alexins* (the mode of origin of which is unknown) the growth of the bacteria is again hindered; in fact, these *sozins* and *alexins*, aided by the leucocytes acting as phagocytes (Metschnikoff), may destroy the bacteria. Canon believes that the chief difference between septicæmia (pyotoxinæmia) and pyæmia depends upon the phenomena, that in septicæmia the bacteria increase and produce their toxins in the blood, whereas in pyæmia the bacteria are introduced into the blood but do not increase there. Brunner holds that there never occurs any marked growth of bacteria in human blood, and he thinks that this is one reason why bacterial blood tests sometimes fail. An acute mycosis is met with in no human infection. He further holds that the micro-organisms are especially prone to collect in the parenchymatous organs, and in the acute cases they set up metastatic processes, which, however, remain microscopically small, the duration of the disease being too short to develop macroscopic foci or to be clinically evident.

The bacteria carried by the blood may be deposited in the various tissues and organs of the body and there continue their activity and bring about local inflammatory or suppurative processes. They may, on the other hand, be destroyed in the tissues and be excreted. The relation of thrombophlebitis to the blood will be discussed later.

All authors hold that in the majority of the cases the ordinary pyogenic cocci, i. e., the pyogenic staphylococci and

streptococci, alone or associated together, constitute the cause of the disease.

The streptococci have long been looked upon as liable to bring about more virulent infections than the staphylococci. But no absolute line can be drawn. We may have an acute or a chronic streptococcus infection with or without metastases. The same is true of the staphylococci. However, many other bacteria play an important part, etiologically, in this disease. The pneumococcus may cause a metastatic-pyæmia, or a pneumococcus-toxæmia, in which the bacteria are found in the blood. Metastatic foci occur most frequently in the meninges and the joints. The *B. coli communis* generally invades the system from the intestinal tract. Cholecystitis, abscess of the liver, peritonitis are often sequela. Cystitis is set up, the bacillus being carried by the lymph vessels or the blood. Meningitis, pneumonia, strumitis, etc., have followed its escape into the blood. It has also been isolated in local phlegmon and lymphangitis. The gonococcus is frequently met with in pyæmic conditions. *B. typhosus*, *B. pyocyaneus*, *B. Friedländer*, *Proteus vulgaris*, *Micrococcus tetragenus*, and many others are capable of bringing about the disease.

The infection may be a mixed one, a double infection taking place at the same time, or a secondary infection taking place in a focus already the seat of microbic activity. It often happens that only one of the bacteria can be demonstrated in the blood, and when streptococci and staphylococci are associated, the streptococcus is generally the one to bring about the general infection.

PATHOLOGY.—In the mildest form of the disease, *septicæmia without bacterial activity*, or, as it is more commonly termed, "*sapræmia*," the pathological changes are limited to the site of the necrosing or putrefying focus. In the *pyosepticæmic* form of the disease we have locally the combined phenomena of pus formation and putrefying, decomposing, or necrosing tissue. It may exist in the form of a moist gangrene. Often, in the case of wounds which seem at first insignificant, but in which cases there ensues a malignant and rapidly fatal toxæmia, the pathological findings are very slight. More often we have the local changes of a pyogenic disturbance, presenting all of the characteristics of local inflammation and abscess formation. The primary focus may be a carbuncle, an infected wound, an otitis media, an osteomyelitis, a gastro-enteritis, a pneumonia, etc. From the seat of infection the inflammation spreads, the lymphangitis is set up, the nodes are attacked, and lymphadenitis follows. The bacteria reach the blood and here many changes occur. *Sozins* and *alexins* are produced, and *antitoxins* are elaborated. Ewing holds that the bacteria are present in the circulating blood only for short periods and at infrequent intervals, and that a few hours before death various bacteria, some of which may not be active in the original process, make their way into the circulation. There is a rapid development of severe anæmia. The red blood cells are diminished in number, and in the more severe cases a slight poikilocytosis and degeneration of the cells occur. Sometimes normoblasts appear. Gravit reports a case of acute septic infection, in which after two days the red blood cells were reduced to 300,000 per cubic millimetre. The blood plaques are increased. Leucocytosis is marked, except in the very mild and very severe cases. Changes in the blood-vessels occur mostly in relation to the local pus foci, but often by means of mural implantation the endocardium is attacked and ulcerative or malignant endocarditis ensues. When a vein in the neighborhood of an abscess is attacked the adventitia is the first to be affected. The ordinary phenomena of inflammation follow, and the other coats of the vein become involved. The intima becomes swollen and inflamed and fibrin is deposited on it, which becomes the nucleus of a coagulum. This increases until the lumen of the vein is occluded and a thrombophlebitis established. Sometimes the thrombus extends for a considerable distance along the vein. As the infective process advances from the primary focus, the microbes invade the thrombus and there bring about