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DEFINITION.—Acute infectious epiphysitis is a disease peculiar to infancy and adolescence, and is due to the specific pathogenic action of one or more of the microbes of suppuration. It is a disease the etiology of which modern bacteriologic research has revealed, and which for more than a century and a half had baffled the most diligent inquiry of able scientific observers.

SYNONYMS.[1]—The disease is best known in the United States by the names of acute infectious osteomyelitis and acute infectious periostitis. Acute infectious arthritis is also applied to a special form of epiphysitis.

HISTORY.—In 1805 J. L. Petit described an acute affection of bone, which we now recognize as acute osteomyelitis. This is the first distinct mention that we have of this disease. Allusions were made

[1] The various synonyms used will be fully discussed in considering the history.

to it also by Gooch, Pott, Cheselden, Hay, and Abernethy.

Bearing on this subject, M. Renaud, in 1831, published a paper "On Inflammation of the Medullary Tissue of Long Bones," and reported five cases occurring after amputation, all of which terminated fatally.

Cruveilhier refers to it as "phlebitis of bones," when suppuration supervened on amputation, and attributes to it the formation of visceral abscesses.

Jules Teilhard La Terrisse first employed the designation acute arthritis of infants in 1831, in his thesis submitted for the degree of Doctor of Medicine, to the Faculty of Medicine in Paris, in which he reported three cases in children, aged respectively three, six, and nine days. At the necropsy pus was found in each case in several of the joints, and in one case a number of abscesses were found in the lung.

Nélaton is credited by Roux as having devised the term osteomyelitis in 1834; in 1844 he published a brief account of it under the title of "Suppuration of Bone."

Mr. Stanley, in 1849, in his monograph on "Diseases of Bone," gives an accurate description of the kryptogenetic, or the then so-called spontaneous variety. Schultzenberger directed attention, in 1853, to this disease as "Rheumatoid Periostitis."

Chassaignac, having studied it in the same year, and recognizing its infectious character, gave to it the name of "Acute Infectious Osteomyelitis," and, for the first time, applied to the spontaneous variety, in 1855, the name "Osteomyelitis," and

detailed four cases that came under his own observation.

In 1855 the affection was described by Becker as "Phlegmonous Periostitis." Almost at the same time Klose published an account of thirteen cases under the term "Meningo-osteo-Phlebitis." In each case there was epiphyseal separation. "Epiphyseal Ostitis of Adolescence" was the term applied to it by Gosselin, at about this time.

Gamet's thesis on this affection appeared in 1862. He entitled it "Juxta-epiphyseal Osteo-periostitis." Geraldès designated it "Phlegmonous Periostitis." V. Roser bestowed upon it the name of "Pseudo-rheumatism," on account of the number of bones involved and the frequency with which the joints were implicated. Luecke is given credit with having first called attention to its infectious character. Lannelongue gave a description of it in 1878, under the heading of "Acute Osteomyelitis of Adolescence."

Mr. T. Smith, a surgeon in St. Bartholomew's Hospital, has reported two cases of "Acute Arthritis of Infants." In his treatise on the *Disease of Joints*, Barwell describes the affection as "Peracute Articular Ostitis;" he also uses the term epiphysitis, taking his definition from Stromeyer's memoirs on *Ostitis Articular Peracute.*

From the frequent occurrence of the separation of the epiphysis from the diaphysis, Klose describes it as "Epiphysentrennung," also as "Meningo-osteo-Phlebitis." Krause called it "Acute Purulent Synovitis in Infants."

MacNamara, in the first edition of his work,

speaks of "Acute Epiphysitis"; but, exception being taken to this term as applied to this disease, in the third edition he refers to it as "Suppurative Ostitis." In the work of Thomas Jones on *Diseases of Bone*, he discusses it under the subject of "Acute Osteo-myelitis and Necrosis of the Epiphyses and Articular Extremities of Bone."

Normal Histology of Bone.—Before considering the etiology or the pathology of acute infectious epiphysitis it is necessary to form a clear and comprehensive idea of this subject, that we should recognize and differentiate between the conditions existing at, and previous to, the completion of ossification, the arrangement of the vascular system, and other special anatomic and histologic peculiarities of the bones, all of which exercise a potent influence in determining pathologic conditions in these structures.

Bone is produced by a temporary cartilaginous substance being converted into medulla. This change is induced by the cartilage becoming pierced by channels or bloodvessels with but an imperfectly developed coat of soft connective tissue, as it is necessary that actual contact should take place between the blood and the cartilage-cells before further development can occur. The cartilage-cells, thus receiving an additional amount of nutriment, are stimulated to increased activity. With the further development of the bone, the periosteum and endosteum are produced, and then we have the bone growing from the cells contained in the medulla, the endosteum, and the periosteum.

The periosteum is developed by the outer layer

of cartilage assuming a reticulated fibroid character, in the meshes of which are contained osteo-genetic cells, and it is by their further and continued development that the bone is increased in thickness.

The bone receives its nourishment not only from the nutrient artery, but also from innumerable small arteries that penetrate into the bone from the periosteum, being derived from arteries of adjacent structures. The arteries are distributed throughout the compact portion of the bone by the system of Haversian canals. In the cancellated structures some vessels follow along the trabeculæ, while others span across the space occupied by the soft marrow. In this situation they bear a strong resemblance to the blood-sinuses in the spleen. The sinuses are larger than the arteries that empty into them. In addition to the veins accompanying the nutrient artery, those arising in the compact tissue and those making their exit through the articular cartilage, there is a venous plexus surrounding the bone at the junction of the epiphyseal cartilage with the diaphysis, greatly facilitating the flow of the blood from this situation. The epiphyseal cartilages receive their blood-supply from the arteries of the medulla.

Continuous with the endosteum in the medullary cavity is a network of adenoid tissue, which is also found accompanying the bloodvessels in the Haversian canals. This is regarded by many authorities as the commencement of the lymphatic system in the bone. In the meshes of this structure are numerous cells both morphologically and functionally resembling the corpuscles in the spleen. The subcartilaginous layer of bone is a dense plate of

compact osseous tissue, situated between the epiphysis and diaphysis. It is pierced by numerous vessels entering the epiphyseal cartilage from the shaft. From its peculiar structure it possesses great resistance to all inflammatory processes. In it there is no definite Haversian system.

The medullary substance occupies the central cavity of tubular bones, and is also continuous with the soft tissues contained between the trabeculæ in the cancellated portion of the bone. At the extremity of the diaphysis it terminates in bulbous processes, and from these numerous other processes are given off, which penetrate the subcartilaginous disc, and, uniting with one another, form arches.

Etiology.—The specific cause of acute infectious epiphysitis is not a special organism, as Becker at one time supposed, but—as determined by Krause, Garré, and Rosenbach, whose researches and observations have been substantiated by many of the more able bacteriologists of the day—this disease is produced by one or more of the varieties of pyogenic microbes the entrance of which into the circulation is usually effected through some abrasion of the skin, or, less frequently, through the mucous membrane of the respiratory or alimentary tracts ; a decayed tooth, or any suppurating inflammatory focus, however small, may be a *portio invasionis*. The organisms have, apparently, a predilection for the long bones, and more frequently attack the one extremity, that from which the development of the bone is principally accomplished, *e. g.* the lower epiphysis of the femur and the upper epiphysis of the tibia.

The short and flat bones are not exempt from the process, and that they are not frequently involved may be ascribed to the fact that their position and function render them less liable to injury, and that the evolving changes in their development are not of such an active character as we have observed in the long bones.

The selective affinity of the microbes for one or the other extremity of a bone, or for any particular class of bones, is not incomprehensible when we study the anatomic structures. We discover that in the medullary tissue, in proximity to the epiphyseal cartilage, where the transitional changes and the vascular supply attain their maximum, and where the blood-pressure and velocity are at a minimum, where the capillaries are mere excavations, sinuses, or have but an imperfectly developed wall, we have all the conditions most favorable for the localization and multiplication of microorganisms, the pathogenic action of which is in health counteracted by the inherent vital resistance of the cells.

Roswell Park asserts that the marrow is "predisposed to collect and retain germs, and that it is most sensitive in its reaction"; from its constitution it also affords a soil that is particularly adapted for their nourishment and proliferation.

As early as 1874, Klebs, Recklinghausen, and others, discovered the presence of cocci in the bodies of patients dying of acute infectious epiphysitis, Pasteur found micrococci, and in 1881 Schüller amputated a limb, and found the same organisms in the bone, periosteum, and articular cartilages.

In the same year Rosenbach cultivated from one case the staphylococcus aureus and albus, from another the staphylococcus albus alone, and from a third the staphylococcus aureus and the streptococcus pyogenes. He also produced the disease in animals by injecting the pus from a furuncle, after subcutaneously fracturing the bone, and with the pus from osteomyelitis produced in the subcutaneous issues a furuncle.

Becker, in 1883, made most careful and extended observations, and thought that he had discovered the specific microbe of osteomyelitis. Rodet has produced osteo-myelitis by the intravenous injection of cultures of the staphylococci, and without fracturing or otherwise injuring the bones; this, however, was possible only by intravenous injection, never in his hands by the mere introduction into the subcutaneous connective tissues. Krause, in 1884, cultivated from the pus the staphylococcus aureus and albus, and found the same organisms in effusions about the joints.

Subsequently, he produced the disease in animals by injecting pure cultures of these cocci, and making subcutaneous fractures. Garré corroborated the experiments of Krause, and also discovered the staphylococcus in the blood. Krause observed lesions in the muscles, kidneys, and other organs identical with those found in pyemia.

Kocher experimented by injecting foul and putrid material into animals, and was sometimes successful in producing the disease. His failure in the other cases was probably due to the fact, that the sub-

stances injected contained none of the pyogenic organisms.

In children that have inherited constitutional taints, as those of tuberculous and syphilitic parents, the resistance to the action of pyogenic organisms is much diminished, so that we find that they are predisposed to osteomyelitis, as also are those that have, or are convalescing from, any of the acute infectious or exanthematous diseases. Thus, T. Holmes, in *The Surgical Treatment of Diseases of Infancy and Childhood*, reports the case of an infant but seven months old, in which suppuration of the hip-joint succeeded an attack of chicken-pox.

Dr. K. McLeod's case of epiphysitis, reported in the *Indian Medical Gazette* for 1883, was attributed to variola. Leucke, Keen, and Renne have demonstrated, and as experience and history of the cases confirm their conclusion, it may be received as a truth, that the specific poisons of diphtheria, typhoid fever, scarlatina, measles, rubeola, and variola, prepare the medullary tissues for the reception of the pyogenic germs.

An influential rôle is assigned to exposure to cold and damp as a predisposing factor, and as the exceeding activity of the tissue-changes in growing bone involves an instability, any sudden change tending to disturb the equilibrium of the circulation will create the conditions necessary for the inception of osteomyelitis. Professor Senn avers to have repeatedly observed cases of osteomyelitis in boys, who, after active and exciting exercise, have plunged in cold water or have stretched themselves out upon the cold ground to rest.

PATHOLOGY.—There are three situations that, according to Howard Marsh, furnish a ready nidus for the localization of microbes, as follows:

"Immediately subjacent to the cartilaginous disc; in the vicinity of the ossifying center; in the line of union between the epiphysis and diaphysis."

Their localization in the diaphyseal side of the epiphyseal cartilage, as in the soft tissues, determines an inflammation in which we may observe the same tissue changes that occur in other structures subjected to the action of these organisms.

There is at first an increased supply of nutrient, quickly followed by a rapid multiplication of the nuclei of the fixed cells.

These cells surround themselves with a layer of granular material, and the whole is encased within a shell of earthy matter, supposed to be elaborated by the nucleus. A poor and lowly organized form of bone is thus produced. This is the analogue of the granulation-tissue found in other structures of the body. The cells, as a result of their rapid proliferation and the unyielding character of the osseous tissue, are crowded together to such an extent that their development is materially interfered with; consequently they offer but feeble resistance to the action of the germs and their ptomaïnes.

When the epiphyseal cartilage is primarily affected, the nuclei of the cells undergo rapid division and subdivision, forming masses of cells, and these conglomerations, the progeny of the cartilage-cells, becoming permeated by bloodvessels, are converted into medulla, which may continue to develop until

it reaches the surface of the articular cartilage, and then we have what is frequently described as an articular ulcer. The process may also extend in the other direction, and communicate with the medullary cavity. Subsequently, we shall have a sinus formed, and an open passageway for the pus between the interior of the joint and the medullary canals.

We perceive that the tissues adjacent to the inflammatory focus are saturated with the transuded serum of the blood, and there are present numerous leukocytes that have migrated from the vessels. We discover, also, that the tissues are stained. This is attributable, not to the presence of serum and leukocytes, but to the hematin that is liberated as the result of the injury sustained by the capillaries, diapedesis supervening, and the red corpuscles having undergone disintegration.

The compact portion does not escape, for we find that the lacunar corpuscles undergo a granular degeneration, and the bone, dependent upon the corpuscles for nutrition and repair, degenerates. Several of the spaces coalescing, a cavity is formed, which ultimately opens into an adjoining medullary space. The shape of this cavity corresponds with the original growth of the lacunar system, thus assuming a more or less circular form. The canaliculi are also filled with this granular material, as are the Haversian canals. This granular substance resembles highly vascularized granulation-tissue. Absorption of the walls of the Haversian canals is the natural sequence of this process. The canals are in consequence greatly increased in diameter,

and rarefaction of the bone is effected. The vessels, not being permitted to contract, remain patulous, thereby facilitating the entrance of microörganisms and their toxines into the circulation.

The veins also participate in the inflammatory process, and we have established a phlebitis, with the formation of infected thrombi. Subsequently, portions of these thrombi become detached and washed into the circulation, and are arrested in some of the viscera. At the site of these infected embolic infarcts we have founded new foci of inflammation, and metastatic abscesses are thus engendered.

One of the peculiar features of osteomyelitis is the local or pyemic condition in the bone, and this is beautifully illustrated in the case here reported (see illustration), in which there were several metastatic abscesses in the medullary substance.

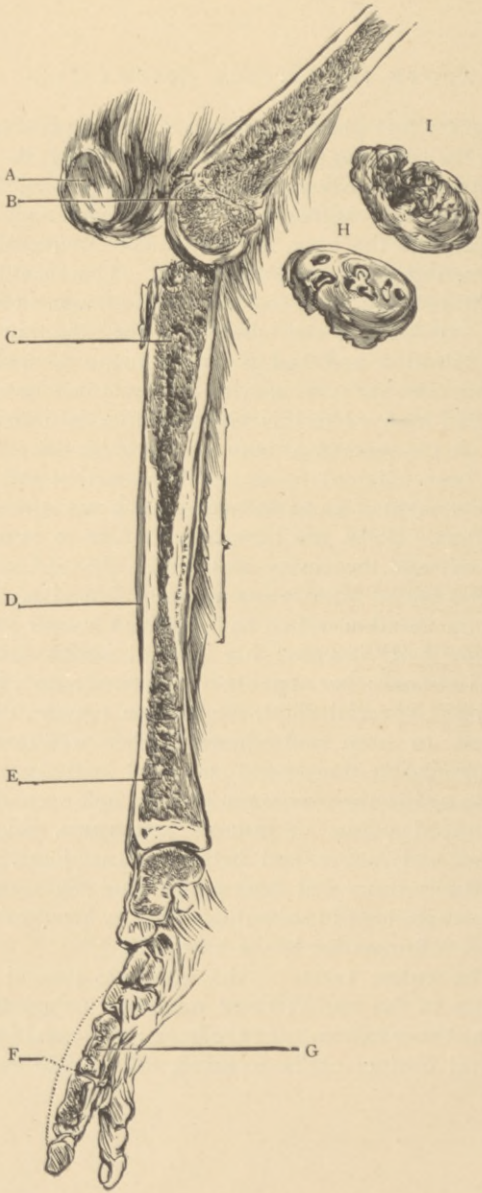
Diastasis is the result of localization of the germs at the juncture of the diaphysis and the epiphysis, or when the integrity of the bone is destroyed by extension of the inflammation.

History of the Case.—In reporting the history of this case, it has not been deemed necessary to go fully into the symptoms, but only to bring out the more important features, which make it differ slightly from other cases reported in the current literature on this subject. The symptoms of this disease have been so fully gone into by the various writers who have considered it, that it is not deemed at all necessary to present an elaborate history, which would, in many points, be but a repetition of well-known and well-established facts.

In the first place, the case was rather peculiar in that the child was thirteen years of age, and that the symptoms had never been active in early life. From the time when she began to walk she had complained of pains in the tibia, occurring more frequently at night, and often preventing sleep. There had been slight swelling, at about four years of age, situated just externally to the tubercle of the tibia, but this had subsided, and had given rise to no symptoms. About one year previously to the time when first seen she had received an injury, caused by a flat-iron falling on the metatarsal bone of the great toe. This had been followed by severe inflammation and the development of a small abscess, which was opened at the time. Some small fragments of bone were removed, and the cavity was freely drained. The wound healed without any apparent difficulty. The pain in the tibia, which had annoyed her for years, became more intense; her general health failed; she lost flesh; her appetite disappeared; and, from a bright, cheerful child, she became morose, disinclined to play, and showed other well-marked symptoms of diminished physical activity. Six weeks before the time when she was first seen there developed points of intense tenderness, situated immediately above and below the knee-joint, and the family states that these points were slightly soft. This was followed in about ten days by symptoms of active inflammation in the knee-joint.

The entire crest of the tibia was painful and tender to the touch; there was some enlargement of the lower extremity of the bone; there was fever; several distinct chills occurred, followed by sweats

FIG. 1.



A. Patella turned backward and to one side, showing its lower surface.

B. The lower extremity of the femur, showing the line of the epiphysis and a distinct border of fatty degeneration just where the epiphysis joins the shaft. In the lower extremity of the femur are several small round or irregular dots that mark the position of metastatic abscesses in the bone. The periosteum of the femur is slightly thickened just above the epiphyseal line. The epiphysis is normal.

C, D, E. Sawn section of the tibia, showing the condition of its medullary canal; at the upper extremity of the tibia the shaft terminates in a jagged, irregular extremity that has been in apposition with the epiphysis. The epiphysis is placed over on one side at H, with a view of the upper surface, while at I the view is that of its under surface. Just above the line that leads from C are two metastatic abscesses of considerable size; below this line, and extending to the line D, is to be noted the detachment of the periosteum. The periosteum is much thickened, the thickening fading off as the line E is approached. At C the bone-marrow was intensely red and congested, and there were no less than a dozen small abscess-cavities not quite as large as split peas. The external compact portion of the bone is much thickened, and just opposite the pointer there is considerable swelling along the line of the periosteum. The lower epiphysis of the tibia does not show well; at the lower extremity of the shaft, however, can be seen several small abscess-cavities. The point G is the seat of the original injury. F marks the metatarso-phalangeal articulation, the lower extremity of which should be placed to the upper extremity, as that represents the sawn section of the bone of the great toe. The great toe is also shown.

H is a view of the superior surface of the epiphysis of the tibia, the articular surface. In it there will be observed not less than five or six small openings that communicate with the abscess below and with the joint above. In some of them small fragments of necrotic bone are to be observed. The cartilaginous structures of the joint are also entirely destroyed, and the articular margins of the epiphysis show a slight fragment of the two semi-lunar cartilages.

I is the same as H, except that it is a view of the inferior surface where it came in contact with the tibia. It will be observed that in the epiphysis there is nothing more or less than an abscess-cavity, the wall of which is formed by a hard cancellated layer of bone and by the articular disc. There was no periosteum continuous with the shaft and epiphysis, and hence the epiphysis moved freely upon the end of the shaft, thus giving the well-known "flail joint" so characteristic of epiphysitis. The interior of the knee contained a considerable quantity of pus, and the synovial structures were also disorganized.

and extreme weakness. The emaciation increased; sleep became impossible, except after the administration of opiates to lull the pain in the infected joint and quiet the nervous system. The symptoms did not seem to respond to any local or systematic treatment, and six weeks after their beginning she first came under our observation.

The physician who had attended the case diagnosticated the condition as one of white swelling, and had so treated it. She was seen by Dr. Allis, Dr. Hearn, and Dr. Coplin, and after a careful study of the case the diagnosis of infectious epiphysitis was made, and an exploratory operation was decided upon. When the knee-joint was opened, the enormous extent of the pathologic process seemed to demand the amputation of the limb, and after gaining the consent of the parents this was done. The accompanying illustration shows the extensive infiltration of the bones affected. There was the "flail joint," and the development of other well-marked symptoms which are usually associated with the disease.

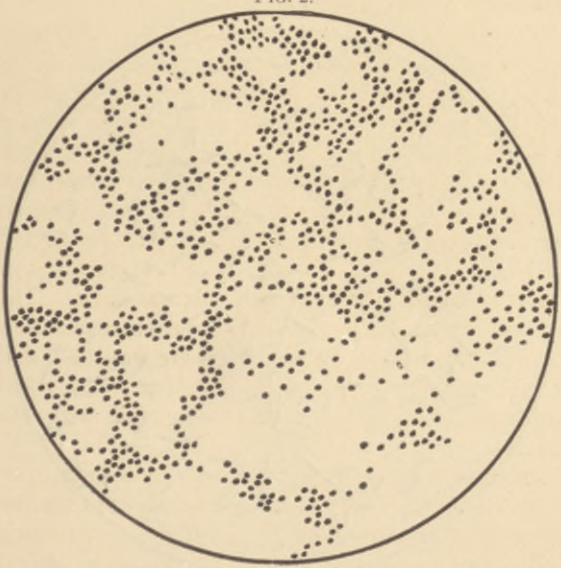
After amputation the girl rapidly recovered.

LABORATORY.—The tubes inoculated from the pus immediately surrounding the joint were, by plating and carrying the cultures rapidly through several generations, proven to contain the following organisms: The staphylococcus pyogenes aureus; the staphylococcus pyogenes albus; the bacillus pyogenes fetidus; the proteus mirabilis.

EXPERIMENTAL PATHOLOGY.—Rabbit No. 1 was injected at 5 P.M. with a culture of the staphylococcus aureus of the first generation. It remained

apparently perfectly well until the day following, when it appeared rather weaker than usual. Its eyes were dull; it ate but little food; and it seemed inclined to doze a greater portion of the time. When seen later in the day, it was extremely

FIG. 2.

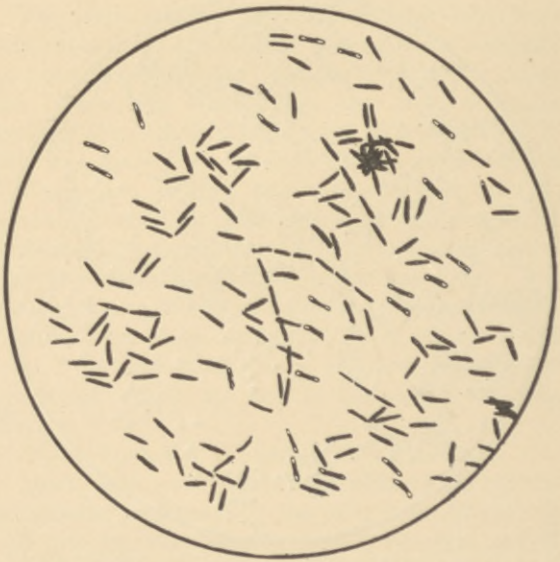


Micrococcus (staphylococcus) aureus—from agar-agar culture; Beck's $\frac{1}{12}$ homogeneous immersion; Oc. 2.

restless; prostration was marked; and there was an inability to coördinate muscular movements. Respiration was shallow, quickened, and irregular; the heart was quick, weak, and the rhythm altered. During the latter part of the day it had refused to

eat and associate with other rabbits. It sought a corner of the cage, where it remained, and was found on the next morning, dead. On post-mortem examination, no microscopic lesions were observed. Death had resulted from septicemia; tubes culti-

FIG. 3.



Bacillus pyogenes fetidus—from agar-agar culture; Beck's $\frac{1}{12}$ homogeneous immersion; Oc. 2.

vated from the blood showed growths of the staphylococcus aureus. This was confirmed by microscopic examination.

Rabbit No. 2 was injected at 8 A.M., June 17th,

with the staphylococcus albus of the first generation. The first symptoms noted manifested selves on them the following day, at 2 o'clock. When offered food, the animal refused to eat, and the same symptoms

FIG. 4.

Proteus mirabilis—from agar-agar culture; Beck's $\frac{1}{12}$ homogeneous immersion; Oc. 2.

succeeded that were observed in the preceding case, although the animal did not so readily yield to the influence of the microbes, not dying until the evening of the 20th. Cultures of the blood and urine showed growths of staphylococcus albus.

Rabbit No. 3 was inoculated on the evening of June 24th with a mixture of the aureus and albus. It died on June 26th, at 3 o'clock, with the symptoms of an intense septic infection. In tubes inoculated a growth of the two cocci developed, as was proven by plating, staining, and microscopic examination.

On June 26th, two rabbits were inoculuted, small quantities of the organisms being employed ; one, No. 4, with proteus, and the other, No. 5, with the bacillus pyogenes fetidus. No lesions were observed at the seat of inoculation. The animals were killed ten days later. There were no internal lesions. The organisms had probably been destroyed by the phagocytes and eliminated by the emunctories ; their absence from the blood being proved by culture-experiments with the intra-cardiac blood and with blood from the kidneys, liver, and spleen.

On Monday, January 12th, rabbit No. 6 was inoculated with staphylococcus aureus, just above the ankle-joint, on the right side. The injury was inflicted by means of a small sterilized gimlet, an attempt being made to puncture the bone, but on account of the dulness of the instrument, and the extreme hardness of the bone, the periosteum alone was injured, the seat of the injury being as near to the epiphyseal line as could be made, without having previously ascertained its location. The injury to the bone, as well as the injection of the micro-örganisms, was effected with the strictest antiseptic precautions, care being taken that the point of the puncture through the skin should not be located immediately above the point of injury of the bone, the

point of inoculation being fully one inch below the point of injury.

On the day following the treatment, the rabbit was dull; it did not eat. At the seat of inoculation was a small point of tenderness, with a distinct area of inflammatory redness. This small point of redness developed slowly into an abscess, requiring nearly a whole week to attain sufficient size to render the diagnosis positive. At this time there were well-marked constitutional symptoms, such as severe rigors, emaciation, weakness, staggering gait, and inability to stand. This condition continued for about five days, when it was noted that the injured limb had rotated directly backward, the plantar surface of the foot being upward; there was well-developed "flail joint"; the limb was considerably swollen, the abscess having evidently extended up the middle third of the femur. The rabbit at this time seemed to have improved in its physical condition; it evinced a desire to eat, and would also run around the cage in which it was confined. The emaciation did not seem to lessen; neither did the rigors entirely cease. The abscess seemed to have diminished in size, but the general usefulness of the limb did not seem to improve in the least; it was limp and useless to the animal.

The animal died on February 12th, and the following post-mortem notes were made: It was evidently emaciated to the last degree. Before any incisions were made in the skin, the condition of the limb was noted as follows: Instead of any well-marked articulation at the knee-joint, the limb was found to move in all possible directions, and crepitus could

readily be obtained. What had been the abscess now seemed doughy and firm, and pitted on pressure. The skin was very carefully dissected from over the seat of the abscess, after which this was opened. The cavity was filled with a cheesy material, which emitted a sweetish odor. It was too thick to flow, and contained large flocculi, evidently necrotic tissue. The knee-joint was entirely disorganized; its capsule was destroyed; the articular cartilages were necrotic; the epiphysis of the femur was separated, and divided into minute fragments, the extremity of the bone being eroded, irregular, and the periosteum removed from its surface as far as the middle third. The abscess had infiltrated the muscle to a slight extent, and in the inguinal region there was an enlarged lymphatic gland, about the size of a shell-bark. The other joints were found perfectly healthy.

The heart was the seat of a slight pericarditis, as shown by the small quantity of flocculent lymph found in the pericardium, also attached to the visceral and parietal layers. This all washed off, and did not seem adherent. The pleura was normal, the lungs thoroughly collapsed, and the seat of several spots of petechial redness; they did not seem to be the seat of any abscesses, and crepitated at all points.

The liver showed marked swelling; its borders were not so sharp and smooth as usual; upon its surface were several distinct creamy white spots, about as large as the head of an ordinary pin; these seemed at first to be on the surface of the liver, but closer examination showed that they were beneath

the capsule, and in the liver-tissue itself. The liver was very friable, and granular in appearance; it also seemed to lack the usual intensely red color found in most rabbits. On section, several spots, identical with those beneath the capsule, could be seen; some of these were removed for microscopic examination. The bile was light in color, and did not stain.

The kidneys were apparently swollen, and their capsule tense; after section, the cut surface could not be placed smoothly together. Along the cortex there were striated lines of congestion, many of them extending far down toward the pelvis of the organ. There were several distinctly white spots of extremely small size, which it was thought might be minute abscesses. To ascertain this, small pieces of the organ were removed for microscopic examination. The organ had no urinary odor, and the urine in the bladder seemed normal.

The other abdominal organs were healthy, except that the spleen was swollen and friable; the peritoneum seemed dryer than usual, and its surface did not look glistening, although no other evidence of inflammation could be detected. There was no apparent enlargement of the mesenteric glands; the retroperitoneal glands were enlarged, and a few had undergone suppuration and caseous formation in their interstices. The general muscular system and joints, other than already noted, were carefully examined, but no evidence of infection could be found.

A microscopic examination of the liver and kidney is appended.

The liver showed numerous thrombotic blood-vessels, and into the perivascular structures and the intercellular spaces rhexis had taken place; the leukocytes had emigrated, and were present in large number. The vessels radiating from the hepatic veins showed stasis, and in points the entire vascular apparatus of the lobule was plugged. The liver-cells were granular, their nuclei not staining. Many of the thrombi were the seat of beginning abscess-formation, as indicated by the young-cell exudate and mycotic invasion. The liver-cells showed the usual changes due to hyperpyrexia; they were granular, stained poorly, and in no small number neither nuclei nor nucleoli were visible; the epithelium of the bile-ducts was not altered.

After staining, so as to bring into relief the organisms, if any were present, the examination was continued with high powers: everywhere in the blood-vessels, perivascular and intercellular spaces, were hosts of microbes; and, what was peculiarly characteristic, mural implantation had occurred and colonies of organisms could be demonstrated within the walls of the hepatic vessels. There appeared to be present bacilli, for which we could not account; but Professor Longstreth expressed an opinion that they were refraction-lines. Staphylococci were present in abundance, and even a casual observer could not fail to note how thoroughly disseminated through the textures they were.

The kidneys, with low powers, showed infarcts, with areas of hemorrhagic extravasation. Small round cells were present in abundance in and about

these areas, indicating inflammation and beginning abscess-formation. The epithelium of the tubes was granular, and degenerating in the highest degree. Indeed, few points were visible in which any of the histologic structures were normal. Many of these changes, like those in the liver, might be attributed to the high temperature. Many of the vasa recta were thrombotic.

With high powers, organisms were found in all portions of the kidney, and especially in and around the thrombi. Some of these microbes could be observed in the interior of the round cellular elements. There were also present rod-shaped bodies, resembling those found in the liver, for which the same explanation is offered as that already given. It is also to be remembered that cocci situated in the interstices of tissues may be stained, and look very much like rod-shaped bodies. This observation is borne out by the fact that by no amount of plating could aught but cocci be cultivated.

Remarks. — There is no specific microbe of epiphysitis or osteomyelitis. The two are practically the same disease—that is, when the latter occurs in adolescence, due to the same organisms, and differing only in the primary site of localization of the germs.

The order of frequency with which the germs are found is as follows: Staphylococcus aureus, staphylococcus albus, staphylococcus citreus, and rarely the streptococcus pyogenes. Unless dependent upon some anomalous condition, epiphysitis never occurs after the completion of ossification, the peculiar construction of the parts and the dis-

tribution of the vessels being necessary and essential elements in its causation.

It is of interest to note, that in the effusion into the tissues, the advance-line of mycotic invasion, saprophytes were not present; neither could they be found in the metastatic abscess in the tibia, nor could any effect be observed by injecting them into healthy tissues of rabbits in quantities insufficient to produce death.

In considering the foregoing fact, it may be confidently asserted that the coëxistence of the bacillus pyogenes fetidus and proteus in the pus, was due not to primary, but to secondary infection. The staphylocci constitute the essential exciting cause of this affection, and they prepare the tissues for the reception of saprophytes. The toxines produced by the saphrophytes increase the danger of septic poisoning.

The staphylococcus aureus excites a more active inflammation than does the staphylococcus albus, and the staphylococcus albus is more active than the staphylococcus citreus, and a mixed infection, especially of the staphylococcus aureus and staphylococcus albus, is the most virulent of all. These facts may be explained by attributing to each variety of microbe the capability of engendering a ptomaïne peculiar to itself. As the result of chemical action from the presence of two such compounds in the tissue, another compound is formed, which, though not differing essentially in its action, acts upon the cell-protoplasm with greater intensity; or the hypothesis may be advanced that the amount of ptomaïnes generated by an organism

is not dependent upon the number, but upon the quantity of the material supplied that it can utilize as food. Hence, it may be assumed that there are present in a part substances that are unaffected or cannot be assimilated by one organism, which to another will serve as an excellent pabulum, and from which the organism will elaborate its peculiar ptomaïne. Therefore, it is evident that if this be the case, we shall have in a given amount of material a greater production of ptomaïnes in mixed infection.

Localization of the organisms is determined by any condition that lowers the inherent vitality or physiologic resistance of the cells, or by any circumstances that disturb the equilibrium of the circulation, as pointed out in considering the etiology. In the case reported by Rosenbach, in which a child was born suffering with infectious epiphysitis, the mother showed no sign of disease ; and in a similar case, personally related by Dr. Joseph Hearn, in which he operated upon a child but three weeks of age, suffering with a peri-articular abscess, the little patient, with the exception of a small sinus, which occasionally discharges a little pus, is apparently perfectly healthy.

A pyemic condition of the bone is a constant attendant upon acute infectious epiphysitis, and if the disease is allowed to progress unchecked, a general pyemia invariably ensues.

In the illustration the number of apertures communicating through the epiphyseal cartilage with the cavity of the abscess, and with that of the joint, will be noted.

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