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The Spavin Group of Lamenesses

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Reprinted from 42d Annual Proceedings of A. V. M. A.

HARTFORD, CONN.
Press of the Case, Lockwood & Brainard Company
1906

The Spavin Group of Lamenesses.

W. L. Williams, Ithaca, N. Y., Carl W. Fisher, San Mateo, California, and D. H. Udall, Ohio State University.

Historically, spavin is perhaps the oldest lameness of the horse. Standing in the foremost rank economically, it has received at least as much, if not more study than any other. Grouped about this malady and certainly allied, if not identical, to it, in cause and pathology, is a long list of separately described affections, some of which may well challenge the supremacy of spavin itself in their frequency and power of diminishing or destroying the usefulness of the horse. We have, therefore, elected to give spavin the title rôle, rather from convenience than from an inherent right of this one affection to dominate the nomenclature of this extensive group. Among the most common and important members of the group, in their approximate order of frequency and economic importance, we would mention spavin, navicular disease, ringbone, sidebone, sesamoiditis, spinitis, gonitis, carpitis, humero-radial arthritis, scapulo-humeral arthritis, etc. In the observations of Dr. Fisher spavin should occupy third or fourth place in frequency.

Taken as a group, they constitute by far the most important lamenesses and, in the destruction of the value of the horse, take high rank among all diseases to which this animal is liable.

Under the title of arthritis sicca or arthritis deformans, numerous writers on general veterinary pathology group these affections together without definitely assigning them to a common cause or suggesting, as a rule, any close relationship beyond the evident similarity of tissue changes, indeed most writers on regional surgery ignore generic identity and treat each as an isolated disease. Without desiring to detract in the least from the excellency of the very extensive literature upon these as separate diseases, we desire to present the entire category as one group of closely allied affections, or, rather, as a malady expressing itself by common phenomena in various parts of the skeletal tissues and in other parts of the integument.

The senior author first had his attention attracted to the group, as such, through observations made as a result of a

professional residence of some duration in the Rocky Mountains, the Mississippi Valley, and in the eastern United States extending altogether over a quarter of a century, in which it was seen that the malady, almost unknown in one region, became a scourge in another part of the country, and between the two extremes offered every possible variation; peculiarities which called for some deeper and more satisfying explanation than accident or traumatism.

Later he enlisted the collaboration of C. W. Fisher, D. V. M., of San Mateo, California, and Professor D. H. Udall, D. V. M., of the Veterinary Department of the Ohio State University, who selected this topic for their joint thesis for graduation at the New York State Veterinary College, and who, during the years from 1899 to 1901, conducted a series of original and highly instructive investigations in relation to its pathology, in which work they were ably advised by Dr. V. A. Moore.

Since the presentation of their thesis, Drs. Fisher and Udall have had opportunities for further valuable observations. The wide geographical separation of the contributors permits the presentation of views based upon data obtained in numerous locations reaching across the continent from the Atlantic to the Pacific, and the subject to be viewed from the standpoint of student, practitioner, and teacher.

The conclusions submitted constitute in general the joint views of the three authors. The major part of the thesis of Drs. Fisher and Udall is presented as such without essential change, for which they assume full responsibility. The responsibility for other portions is accepted by the senior author.

The very instructive, though all too few, urinalyses herein quoted are the work of Dr. George W. Cavanaugh, Professor of Agricultural Chemistry, Cornell University, the samples and clinical data having been supplied by the senior author.

PATHOLOGY.

This affection or group of affections having been generally viewed as the result of a traumatism, the pathology has been chiefly studied in the light of separate localized maladies, consequently each has had its morbid anatomy investigated and described separately, each description being a repetition of the other varying only in the predominance of this lesion in one,

of that in another. True, here and there an author has vaguely hinted at the systemic etiology of one or another member of the group, as has Dieckerhoff (Der Spat des Pferdes) in recognizing brustseuche as an essential cause of some cases of spavin.

During the period of our study and subsequent to the preparation of the thesis mentioned, Messrs. Vivien and Augustin, in the *Revue Generale de Leclainche* for July, 1904 (Am. Vet. Review, Nov., 1904, page 712), came forward with a thesis ascribing this group essentially to systemic disturbances and assigning to trauma a secondary rôle so that, working without knowledge of the trend of each other's investigations, the general conclusions have proven parallel in some of their leading features.

In dealing with the pathological anatomy, it is not essential for us to enter into it in detail, since the data published by any one of several authors would necessarily be repeated, and if included as related by any one of them regarding one of the group of maladies, would serve for a description of the lesions of any other one or all of them almost indifferently. Were we to take the descriptions of the lesions of spavin by Percivall, Dieckerhoff or Eberlein, they would, in a large measure, correspond, varying somewhat because of the bias of each as to the etiology of this affection, and if we set aside the influence of this belief, then each description would serve equally well for ringbone, navicular disease or other member of the group. If we select from the most extensive and recent investigations in the histology of these affections, we would mention Eberlein (Monatshefte fur Praktische Thierheilkunde, Vol. IX, pp. 1-49) as to spavin, and Karnbach (Monatshefte fur Praktische Thierheilkunde, Vol. XI, page 516), and Udriski (Ibid, page 337) on ringbones.

The initial point of the disease process is variously held by different authors, in harmony with their views as to the cause. If the systemic hypothesis of Vivien and Augustin and that of ourselves be accepted, the pathologic orgin is general, and the controversy has been waged over the first region of visible intensity, which may vary in different cases. The disease, according to our observations, affects the entire skeletal system, involving primarily the general system and causing constitutional disturbances, of which the arthritis becomes the local

manifestation. With such a view, it follows that no articular tissue occupies a first place in the history, but any one of the tissues concerned may be the first to become visibly affected.

Bone and Articular Cartilage. The short bones, composed of cancellated tissue and having an abundance of red marrow, take a prominent, if not the chief part in the known pathologic changes, and, according to many recent investigators, is the tissue in which the first visible lesions of the disease appear.

These lesions are first discoverable chiefly in the subchondral layer, and may be seen by the naked eye in early stages as variable sized, dark reddish-blue spots through the comparatively transparent articular cartilage, as is shown at 1, 2, 4, 5, 6, 7 in Fig. I and at B in Figs. II and III. These areas are irregularly circular in form and tend to occur simultaneously at corresponding points on the ends of the two bones concurring in the articulation.

Histologically examined, the Haversian canals widen greatly, assuming sac- or ampulla-like enlargements designated Howschip's lacunæ. The bone cells decrease in size, their prolongations disappear and their outline becomes more regular. The canaliculi vanish in the severely affected parts. The bone matrix liquefies, forming cavities of considerable size, and, by extension toward the articular cartilage, finally reaches it, and the granulation tissue interrupting the nutrition to the superposed cartilage, it, too, becomes involved. The disease of the cartilage generally begins in the deepest layers, bordering the subchondral excavations in the osseous tissue, the superficial cartilaginous layers remaining for a time intact. The disease processes within the cartilage are analogous to those taking place in the bone. The cartilage cells multiply, enlarge, lose their normal character, and assume the appearance of giant cells or osteoclasts. The chondral matrix softens, becomes fibrillated and destroyed. When the superficial layer of cartilage is finally dissolved or thoroughly undermined by the erosive process taking place in the subchondral bone, it breaks and falls into the excavation beneath, forming deep pit-like cavities, opening upon the articular surface by a mouth usually much smaller in diameter than the excavation beneath, producing the macroscopic appearances shown in Figs. II IV.

These pits appear to be always the seat of active inflammation, are occupied in part by tissue débris which has become

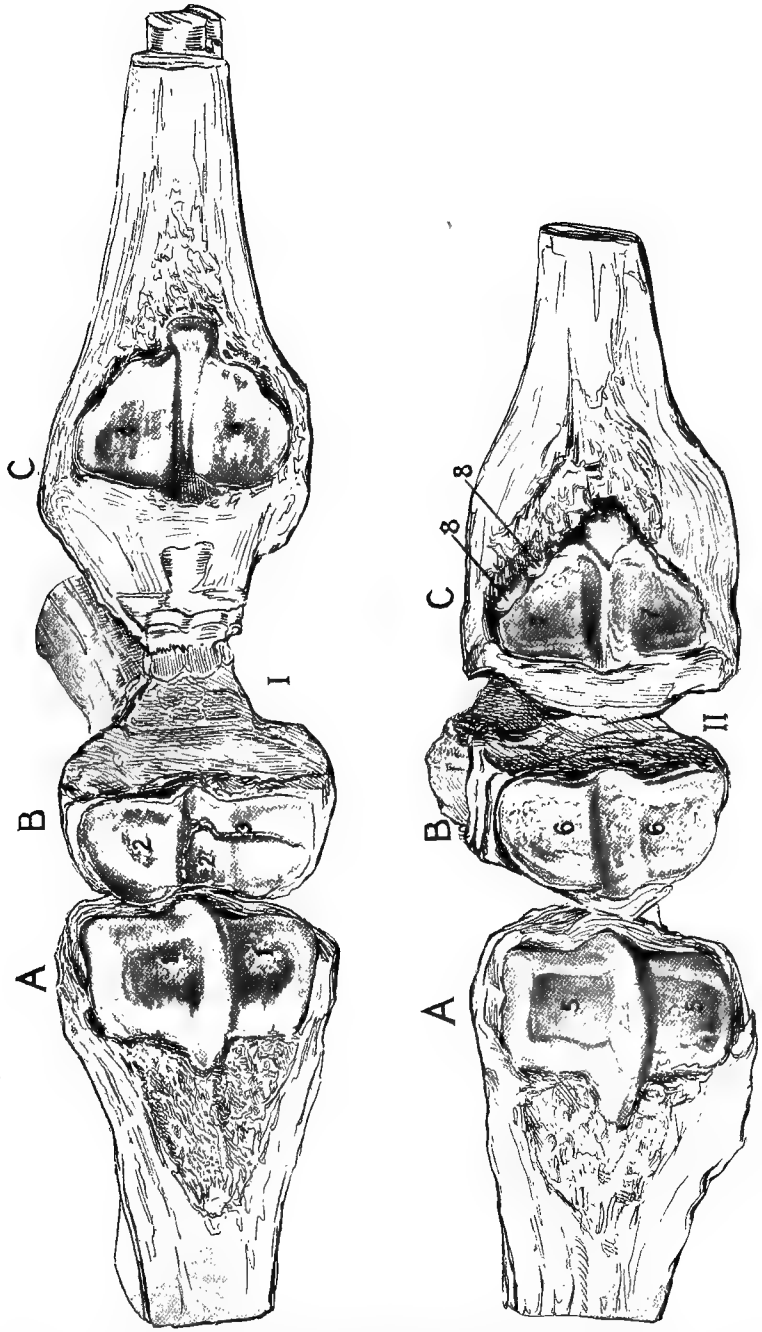

FIG. I. — Symmetrical sesamoiditis. A, Metacarpus; B, Suffraginis; C, Sesamoids.
I. 1, 2, 4, Erosions of articular cartilage, with darkened background. 3, Repaired fissure of the head of 1st phalanx.
II. 5, 5, Erosions apparently from friction. 6, 7, Erosions with dark background. 8, 8, Exostoses on sesamoid bone.

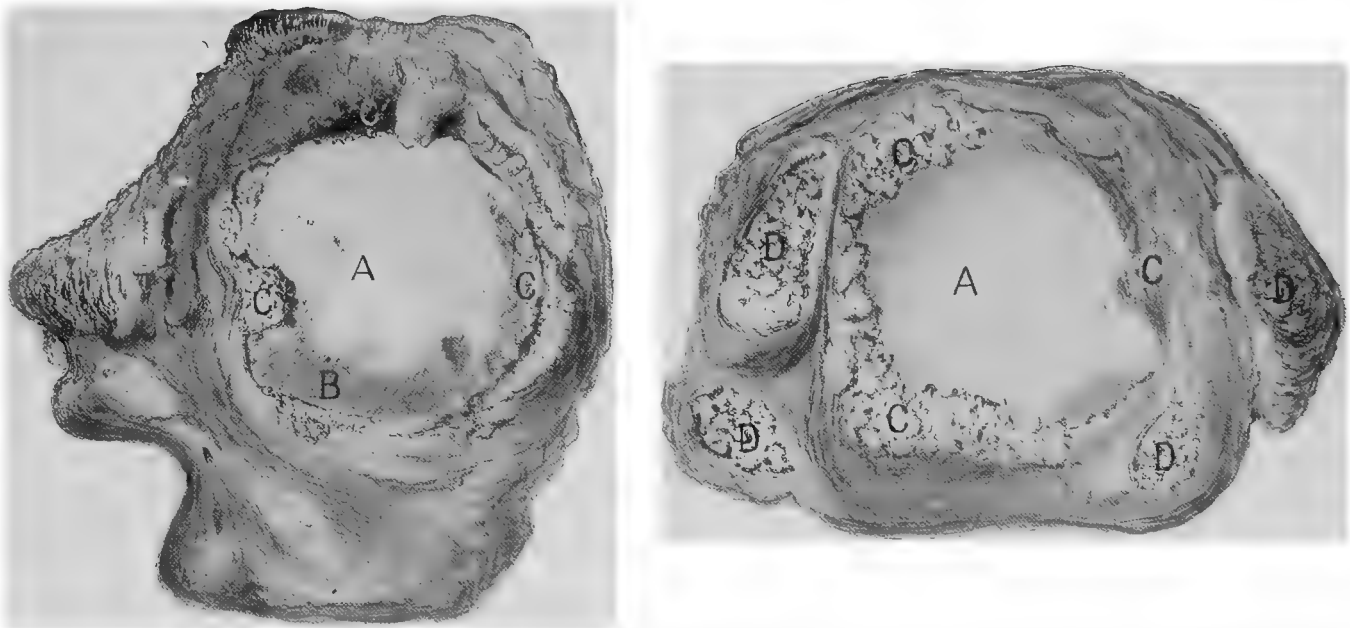

FIG. II.—Scapulo-humeral arthritis, drawn from wet specimen. Scapula at left; humerus at the right. A, A, Approximately normal articular cartilage. B, B, Articular cartilage resting immediately upon dark, inflamed areas of bone. C, C, Erosions of cartilage and bone at circumference of joints, the pits filled with necrotic debris. D, D, Necrotic masses of debris imbedded in the enormously thickened capsular ligament.

FIG. III. — Longitudinal Section of humerus, shown in Fig. II.
A. Approximately normal articular cartilage.
B. Darkened area in bone, due to intense inflammation, corresponding to the dark areas in FIG. II.
C, C. Erosions at margin of articular cartilage.

FIG. IV. — Spavin. Section through the lower tarsal row and metatarsus showing condensing ostitis, with marked osteo-sclerosis in tarsal bones.

necrotic and fallen into the cavity, or the red marrow may proliferate, and a mass consisting of connective tissue, vessels, and lymphoid marrow cells completely occupy the cavity if the superficial layer of cartilage remains intact. The amount of necrotic tissue dêbris is unusually abundant in Figs. II and III at C.

If the superficial cartilaginous layer has broken down completely and the excavation has acquired an opening into the articular cavity, the granulation or marrow tissue may grow up into the joint cavity, and, meeting there with prolongations from corresponding erosions in the opposing bone, the two may fuse, producing fibrous anchylosis which constitutes in a measure a reparative process.

The reparation of the affected parts is largely a reversal of the processes just outlined. The bone cells, lymphoid marrow cells or osteoblasts resume their normal properties, the osteoclasts largely disappearing, new osseous lamella form about the Haversian canals, new lacunæ and canaliculi appear, and instead of rarefying ostitis, we observe an ostitis condensans, which generally more than replaces the prior bony lamella, producing an osteo-sclerosis as shown in Fig. IV, in which the former porotic bone has become exceedingly dense, almost like ivory. This represents the recovery of the osseous lesions in the most complete form we are able to recognize.

If the marrow cavities which we have described push their way near to or upon the surface of the joint and ossification of these prolongations take place, they cause hard, rough, pointed elevations or calcified points, readily felt in some cases upon the joint surface, and capable of causing friction erosions on the opposing articular surfaces.

Following the fibrous anchylosis, the prolongations tend to become ossified, producing an osseous anchylosis of varying degrees of completeness. Rarely the entire joint surface becomes denuded of articular cartilage and the anchylosis may then become complete, but generally there are islets of articular cartilage of varying sizes, which leave the anchylosis incomplete, and according to incompleteness, insecure, exposing it to interruption or fracture resulting in a renewal of pain and lameness.

In other cases the prolongations of red marrow with their vessels and connective tissue fibers fail to fuse with those from the opposite joint surface, but push against them and into any depressions or cavities in the opposing surface, the prolongations

being irregularly conical, the projections from the two opposing surfaces alternating and interlocking in a way to produce a false anchylosis competent to fix the joint to a limited degree without giving the security of a true and complete fusion.

PERIOSTITIS AND EXOSTOSES. As we have already suggested, the ostitis is general, with here and there points of special virulence which determine gross lesions. These areas of intensity are not always subchondral, but are possibly even more frequently subperiosteal, leading to the formation of exostoses, which constitute the most universally visible lesions of the malady.

In many cases the subchondral and subperiosteal lesions are simultaneous, as is shown in Fig. V, where the destruction of the articular cartilage and the exostoses are equally prominent. In other cases, as seen in many peri-articular ringbones (Fig. VI), the areas of intensity are chiefly subperiosteal and the articular cartilage largely escapes destruction. When the inflammation involves the periosteum, it is generally in the immediate vicinity of the attachments of the capsular ligaments.

Instead of the destructive processes, we have outlined in the osseous tissue, the periosteum, when the seat of the disease, tends to a productive inflammation. The deeper osteogenetic layer assumes increased activity, the osteoblasts multiply, and new osseous tissue is rapidly formed. The Haversian canals extend outward from the normal into the new formed bone. The new osseous tissue possesses all the essential characters of normal bone, but the regularity is disturbed in various ways. The Haversian canals are larger and more irregular in arrangement, the new bone is softer and more fragile. Its outline during life appears somewhat smooth and regular, but when the affected bones are macerated and the connective tissue removed, the surface is found to be very irregular with many deep indentations passing into the exostoses, dividing them up into irregular adherent bony masses. The new formed bone tends finally to undergo osteo-sclerosis when the active stage of the disease has passed, and may in time atrophy.

SYNOVITIS. Synovitis is a well-nigh constant condition in this affection, and while it apparently bears a close relation in many cases to the usury of the articular cartilage, this does not seem to be constant, nor can synovitis be recognized in all cases, either *intra vitam* or *post mortem*.

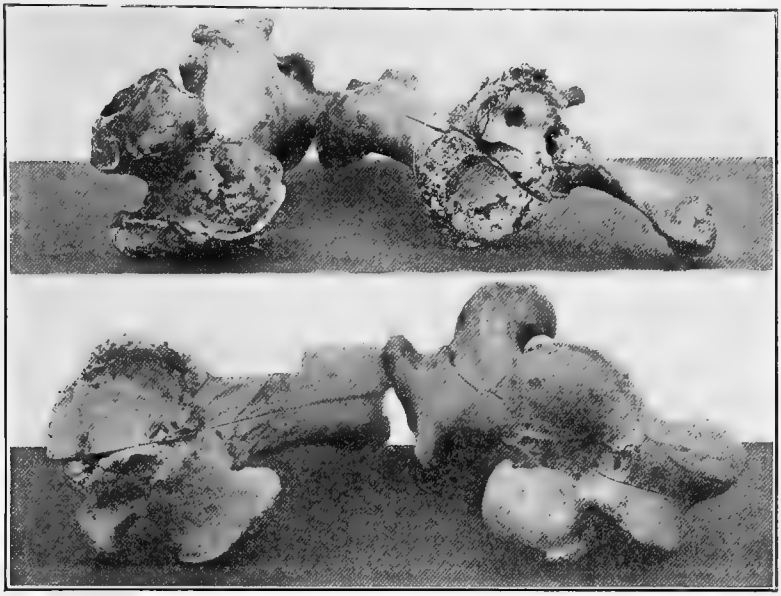

FIG. V. — Humero-radial and femoro-tibial articulations, showing extensive disease, with deep erosions and abundant marginal exostoses. The specific gravity of these bones is greatly decreased.

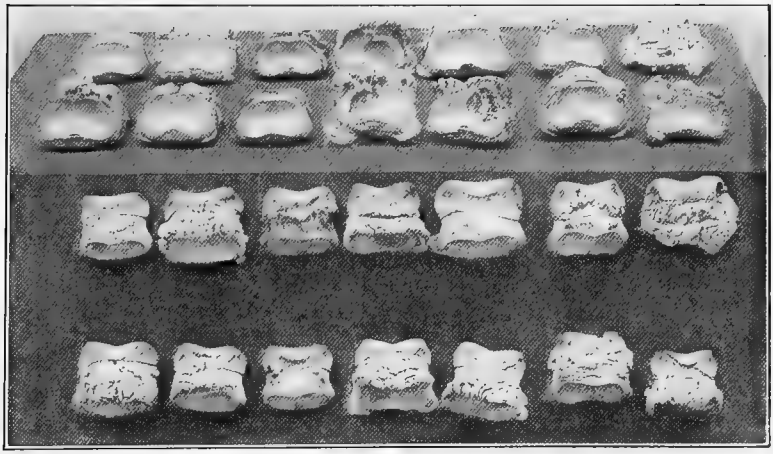

FIG. VI. — A series of ringbones, showing in the two upper rows the interphalangeal articular surface, with erosions; and in the lower rows the same specimens showing the exostoses.

FIG. VII. — A series of navicular bones, showing variations in erosions, pit-like excavations and exostoses.

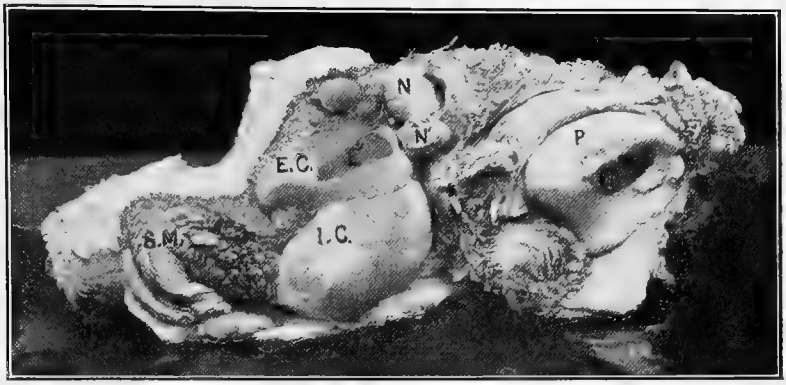

FIG. VIII. — Femoro-patellar articulation (gonitis), from Case IV. S. M., Synovial membrane, thickened and tufted. N, Calcified nodule in the walls of the articular capsule, from which suspended by a narrow neck, is a second nodule, N′, which might readily become a floating body. E. C, Diminutive and flattened external femoral condyle, between which and the enlarged internal condyle, I. C., the trochlear groove is practically wanting. P, Patella, showing at E, an extensive erosion, caused by friction in passing out and in over E. C. at E′, the result of "floating dislocation of the patella."

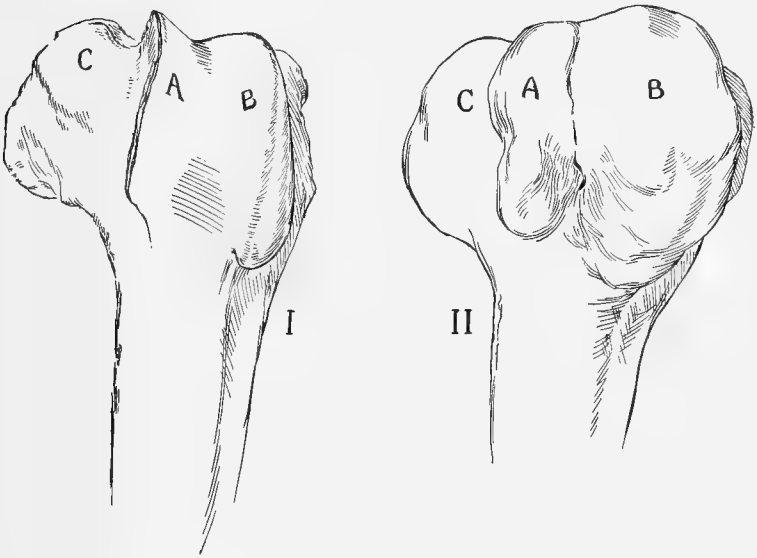

FIG. IX. — Gonitis and floating luxation of the patella in eighteen-months colt.

I. Normal femur. II. Diseased femur from Case IV, showing another view of the femur in Fig. VIII.

A, External condyle. B, Internal condyle.

In I, the external condyle is sharply defined and well elevated above the sulcus, while in II the condyle is rotund, flattened with almost no depression or groove between it and the internal condyle. The differences between the two internal condyles is very much greater. The normal (I) is well-defined and sharp, while the diseased (II) is greatly enlarged, puffed up, and undulating at its upper part. There is in II no trochlear groove in which the patella may glide, and no external trochlear ridge to guide it; hence patella slipped out and in position at each step.

It is most apparent when the intense areas of the disease involve an important articulation. The character of this synovitis has been in controversy. Many of the older authors speak of this affection in a general way as arthritis sicca or dry arthritis, but, when they do so, they have in mind, apparently, only those joints of limited motion and scant synovia. It is essential for repair in cases of developed spavin or ringbone that eventually synovia should cease to be secreted in order that contact of the denuded bones may occur and permit anchylosis. In these articulation there are only very limited synovial sacs incapable of distension, and severe inflammation apparently quickly destroys, or diminishes, their secretory power. In the larger articulations with extensive synovial sacs, the secretion becomes very greatly increased. In many cases of spavin, presumably without erosion of the cartilage of the tibio-astragaloid articulation, the synovial sac of this joint is greatly distended, constituting what we may well term a false bog spavin in contradistinction to the generally greater distension of the joint, sometimes unaccompanied by lameness, or, so far as we know, by any osseous disease, to which we ordinarily apply the term of bog spavin. Ths distension serves to cover and disguise the exostosis of spavin and in this way tends to lead to error in diagnosis. It is a part of the one affection, the synovitis of ordinary spavin having the same etiology and prognosis.

Still more pronounced, and quite characteristic of the malady, is the synovitis in gonitis. There the distension of the femoro-patellar bursa is, next to the lameness, the most prominent sign of the malady and, moreover, its results are serious for the integrity of the articulation. When occurring in young animals, the extreme distension of this sac lifts the patella upwards and forwards, until it is above the external trochlear ridge, inducing a floating dislocation of the patella, as seen in Figs. VIII and IX. The floating patella is drawn outwards over the external ridge by the biceps femoris and other muscles during flexion, and inwards again during extension, the resulting attrition wearing away the cartilage and bone from the summit of the external trochlear ridge and from the median ridge of the patella, as shown at E and E^1 in Fig. VIII.

The increased pressure upon the summit of the ridge, the disuse of the trochlear groove and the internal ridge, along with the disease processes, taking place within the articular

end of the bone, bring about serious deformities in the joint. The external ridge loses its cleanness of outline, flattens down and becomes practically level with the bottom of the sulcus, while the internal trochlear ridge puffs up, enlarges in every direction, is rounded and obtuse everywhere; the trochlea has lost its function as a conduit for the patella and the efficiency of the joint is permanently and incurably destroyed. Compare Figs. VIII and IX. If we examine one of these articular cavities, it is found filled with an excessive amount of transparent or semi-transparent, faintly reddish or yellowish, thin synovia.

The synovial papillæ are hypertrophied, greatly thickened and elongated, as shown at S M in Fig. VIII, and some of the more prominent are calcified at their free extremities, as shown at N, while another nodule, N^1, is attached to it by a narrow neck, which time or accident may cause to part, and a free body in the joint result.

In many cases the articular capsule is thickened and indurated, sometimes becoming enormously so to the extent of one-half to one inch of dense fibrous tissue, and, rarely, within this dense mass may be found large masses of necrotic tissue débris, as shown in Fig. II at D D.

The following portions, to and including page 298, is an abstract of the thesis already referred to. The outline of the work was planned by Professor W. L. Williams, and the microscopical technique largely under the supervision of Professor V. A. Moore.

Material and Methods of Investigation. — In the investigation of this disease we have had recourse to the clinical cases of the New York State Veterinary College. The material for both clinical and post mortem examination has been more than sufficient to occupy the available time devoted to the work. In some cases the history of the patient has been somewhat deficient, yet enough has been given with the majority of them to trace the origin and character of the clinical symptoms.

The following scheme has been employed as a working basis, but the amount of time required for carrying out the experiments has of necessity confined us to a limited portion of the original outline.

I. Gross examination.
  A. Physical.
    (*a*) History of animal.
    (*b*) Character of lameness (local, general).
    (*c*) General condition of the patient.
  B. Anatomical examination of joints and extremities.
    (*a*) Amount and character of synovial fluid.
    (*b*) Character of synovial membranes and capsular ligaments.
    (*c*) Condition of articular cartilage.
    (*d*) Character of deformity.
II. Urine analysis.
    (*a*) Determination of reaction.
    (*b*) Amount of phosophates and other solids.
III. Pathological examination of the tissues.
  A. Bone (macroscopic and microscopic changes).

Preparations of bone for microscopic examination were made in the following manner: Small pieces of fresh tissue were fixed in an alcoholic-sublimate solution, or in picric alcohol; these were hardened in ethyl alcohol by placing them first in that of fifty per cent. strength, then removed to that of sixty-seven per cent., eighty-two per cent., and ninety-five per cent. respectively; the hardening process being complete in from three to five days. Specimens that were fixed in the alcoholic solution of corrosive sublimate and hardened in alcohol were employed for filed preparations, which were excellent for demonstrating the inorganic structure of the bone. To bring out the structure of both the organic and inorganic tissue it is necessary to decalcify. The following fluid was used for this purpose: sixty-seven per cent. alcohol, ninety-seven parts; concentrated nitric acid, three parts. The methods of technique may be found in "Normal Histology," Piersol. The sections were stained in hematoxylin and picro-fuchsin and mounted in Canada balsam. Several other stains were used, but the above were the only ones that gave satisfaction.

Examination of Subjects.

Case 1. — A bay mare fifteen years of age, brought to the clinic in the spring of 1900 to be treated for lameness in the right hind limb.

Symptoms: anæmia; slight ventral hernia; lameness very marked, especially in the hind limbs; well developed gonitis on the right side; upon urging the animal to trot she appeared to be lame in every joint.

Autopsy:— Left anterior extremity: scapulo-humeral articulation; the articular cartilage was roughened on the head of the humerus; the synovial membrane discolored. Elbow joint: the cartilage on the trochlea of

the humerus contained an ulcerlike depression, one-half by five-eighths of an inch in size; a similar roughness was present on the articular surface of the ulna. Carpus: cartilage slightly eroded between the articular surfaces of the os magnum and radius, and between the small carpal and metacarpal bones; on *microscopic* examination the cartilage was found torn, villous, and fibrous; the cartilage cells proliferated and enclosed in mother capsules. The osseous tissue of the os magnum was abnormally hard and many of the marrow cavities were empty, while others were completely filled with marrow cells; the canaliculi of the lacunæ had undergone marked atrophy, this was also true of the protoplasmic extensions of the bone corpuscles; many of the bone corpuscles (cells) within the lacunæ assumed a roundish form.

Right posterior extremity: femoro-patellar articulation: the synovial fluid had increased in amount; the articular cartilage presented extensive erosion on the inferior surface of the patella; the entire surface of the fibro-cartilaginous process eroded; the corresponding surface of the femur had undergone similar changes but not discolored. Femoro-tibial articulation: cartilage extensively eroded, in places the atrophy was complete. One of these areas presented a polished surface one and one-fourth inches by three-fourths of an inch in diameter, portions of the cartilage in places had undergone osseous degeneration. The *histological changes* identical with those of the carpus; metaplasia of the cartilage matrix and arrangement of the proliferated cartilage cells in mother capsules. Tarsus: cartilage absent over a small triangular area on the distal extremity of the tibia; bony exostosis in the form of a spavin. Fetlock: discoloration and roughness on the internal condyle of the first phalanx.

Left posterior extremity: femoro-tibial articulation: cartilage roughened; synovial membrane discolored; capsular ligament thickened; the histological changes were the same as previously described. Tarsus: tibio-astragaloid articulation: normal. Astragalo-scaphoid articulation: cartilage atrophied in the form of erosion-like ulcers that reach to the bone; bursa of cunean tendon normal. Fetlock: cartilage and bone normal; tendon sheaths discolored.

Conclusions: An examination of the bones of this animal suggested that the diseased processes were well advanced. Exostoses and proliferative changes in general seem to have reached a termination; the solidity of the bone itself and appearance in the marrow cavities indicated a condensing stage of the disease. Although a few of the marrow cavities were entirely filled with cells the greater number were comparatively empty so that large open spaces were visible. (Figs. X and XI.)

Case II. — A small bay mare, advanced in age, brought to the clinic to be destroyed because of chronic navicular disease. Clinical examination revealed no exostoses.

Autopsy:— Right anterior limb: bursa podotrochlearis: cartilage and tendon roughened, the bone was also affected. Suffragino-coronal articulation: the proximal extremity of the second phalanx presented areas of discoloration near the center, upon removal of the apparently normal cartilage these punctiform areas were seen to be present in the bone.

Left anterior limb: articulations apparently normal. Bursa podotro-

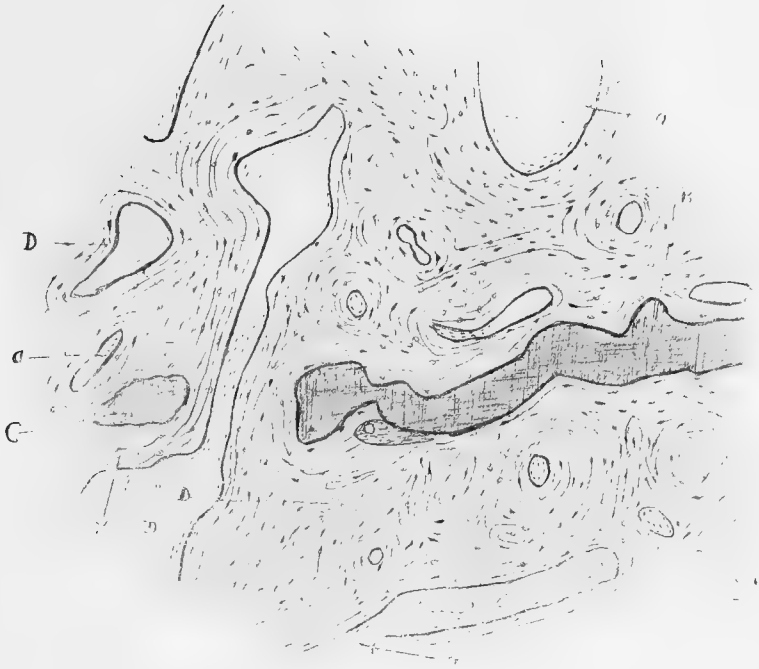

Fig. X. — Section through cuneiform magnum and medium, demonstrating osteo-sclerosis and anchylosis. a, Marrow cavities containing relatively few marrow cells. B, C, Articular cartilage. D, Lacunæ, many of which contain no bone cells. x, Norma bone cells x, 50. Case No. I.

Fig. XI. — Section through cuneiform magnum and medium, demonstrating osteo-sclerosis and anchylosis. x, 450. A, Marrow cavity containing relatively few marrow cells. B, Articular cartilage. D, Lacunæ containing no bone cells. x, Lacunæ containing bone cells; atrophy of the cells and canaliculi are common. Case No. I.

chlearis: the tendon over the navicular bone was extensively roughened.

Posterior limbs: small nodular exostoses were found in the region of the tarsal joints; firm anchylosis of the cuneiform magnum and medium, the latter also anchylosed with the metatarsi. Cunean bursæ obliterated, there being a firm union between the tendons and the bone.

Case III. — A thirteen year old mare. Eight years ago she suffered from lameness of the anterior limbs, and although vigorous, stumbled frequently when driven. This condition was present up to the time of death. Disease of the hind limbs was not diagnosed during life.

Autopsy: — Right anterior limb: scapulo-humeral articulation: cartilage slightly roughened over the head of the humerus, it appeared to be roughened and thinner than normal. Carpus: cartilage covered with ulcer-like depressions between the upper row of bones and radius, small pieces of fibrous tissue floated in the depressions; slight lesions present on the distal end of the metacarpus.

Right hind limb: femoro-tibial articulation: articular cartilage almost completely atrophied over the median trochlea of the femur; the latter bone was very porous at its distal end, the handle of a bistuory could easily be pushed into the osseous tissue for a distance of one and one-half inches.

Left hind limb: femoro-tibial articulation: lesions allied to those found in the corresponding limb, the trochlea of the femur was less porous.

Case IV. — Patient presented at the clinic April 3, 1900, when the following notes were made: age one year, diet four quarts of oats and ten pounds of hay daily. Patient to be treated for gonitis first noticed about April second, and from which the animal appeared to be very lame. Clinical examination revealed one gonitis, two spavins, and four ringbones. This animal was killed in December of the same year because of a chronic luxation of the patella.

Autopsy: — Left hind limb: femoro-patellar articulation: synovial membrane distended with a large amount of fluid; extensive thickening of the capsular ligament; erosion of the external trochlea of the femur and roughness of the internal condyle. The external trochlea very compact, the inner soft and porous. Femoro-tibial articulation: the changes were similar to those in the preceding. Free bodies were found in the joint composed of bone, cartilage, and connective tissue. *Histological examination;* the trabeculæ and osseous portions of the marrow cavities well marked, the latter containing many giant and lymphoid marrow cells. The giant cells were not all in direct contact with the trabeculæ, some were situated in the middle of the marrow cavity. Tarsus: bones apparently normal; the cartilage exhibited small, punctiform, reddish-blue spots about two millimeters from the external margin of the articular surface. These correspond to those mentioned by other investigators ("points of contact" of Eberlin). Upon a histological examination of a section made through one of these points the following conditions were noted: the cartilage cells grouped in an irregula manner, their form more rounded and somewhat larger than in a like section of normal bone. An empty cavity was noted between the cartilage and

bone (Fig. XII), which may be due to mechanical manipulation of the tissue. The following changes were noted in the bone: the canaliculi of the lacunæ entirely atrophied in the region of the empty space (Z), the lacunæ roundish in form, the marrow cavities completely filled with cells and capillaries (Fig. XII, D[1]). The bone apparently in a condition of active hyperæmia; obviously a case of osteo-porosis in the early stages.

Case V. — A bay gelding draft horse twenty years old, bred and raised upon the University farm. The diet consisted of hay with five pounds of corn and oats mixed night and morning, and five pounds of oats at noon. The animal had always been vigorous and in excellent health. April seventeenth, nineteen hundred, he was presented to the clinic to be treated for lameness in the hind limbs, which had come on gradually, and at times was not noticeable. Diagnosed as gonitis. The following October the animal was returned to the clinic without improvement and owing to his age and severe lameness was left for disposal.

Autopsy: — Pronounced changes were found on the proximal extremities of both tibial bones; articular cartilage entirely absent from median side of left tibia, around this area the cartilage was very much thickened. Exostoses in the form of nodules were abundant around the articular surfaces, some were firmly attached while others were held in place by fibrous tissue. The articular cartilage of the condyles of the femur presented a rough appearance; slight abrasions were found in some of the other joints. Histological examination, thin sections from the proximal extremity of the tibia presented bone and cartilage undergoing rapid and complete degeneration (Fig. XIII); the solid bone matrix (trabeculæ) had lost nearly all of its characteristic structure; the lacunæ were entirely absent over a great extent of the sections examined. Just beneath the abraded cartilage (Fig. XIII, A) the changes were very marked, only an occasional round space indicated the presence of a former lacunæ. The marrow cavities visibly enlarged and entirely filled with marrow cells, among which were many giant cells (Fig. XIII, D); Howschip's lacunæ were abundant.

Examination of this bone with a microscope that magnified fifty diameters revealed many places where the marrow cavities and trabeculæ had a very similar appearance; the cavities were so completely filled with cells and capillaries, and the bone had lost so many of its typical features that a higher magnification was necessary to determine the exact location of the boundary line. In certain of the marrow cavities reparative processes were beginning to take place. Marrow cells that had the appearance of osteoblasts in developing bone of young animals were arranged around the periphery of the cavity in contact with the bone trabeculæ. Blood vessels and connective tissue were present as in the reticular tissue of normal bone marrow, the amount of such connective tissue, was, however, abnormally small. The areas in which reparative processes were taking place were very small in comparison with the whole amount of diseased tissue; they were very suggestive, however, of the method by which such osteoporotic bone may become hard again, and finally pass to osteo-schlerosis.

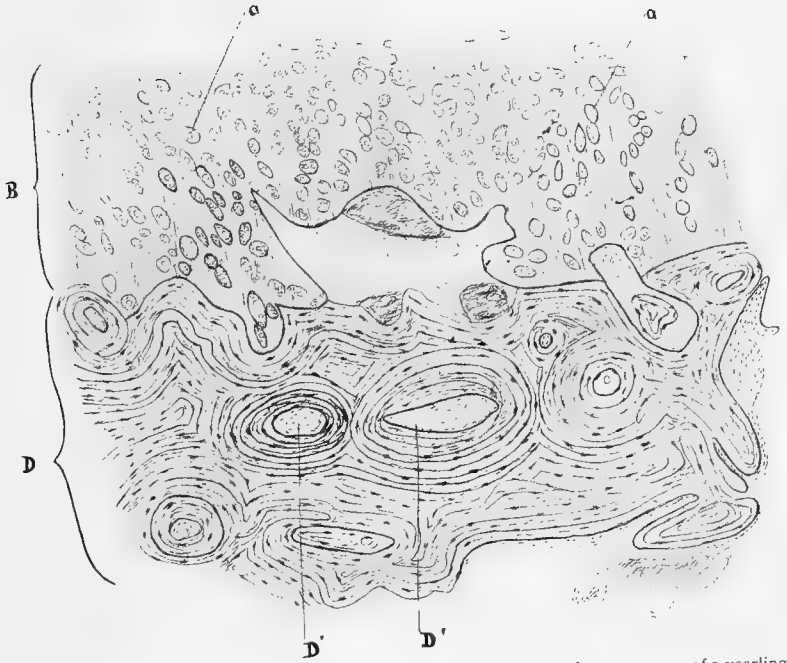

FIG. XII.— Demonstrating osteo-porosis in the early stages from the os magnum of a yearling colt. X, 50. Case No. IV.

A, Cartilage cells, round in form and irregularly grouped.

B, Cartilage.

D, Bone.

D', Marrow cavities, completely filled with cells and capillaries.

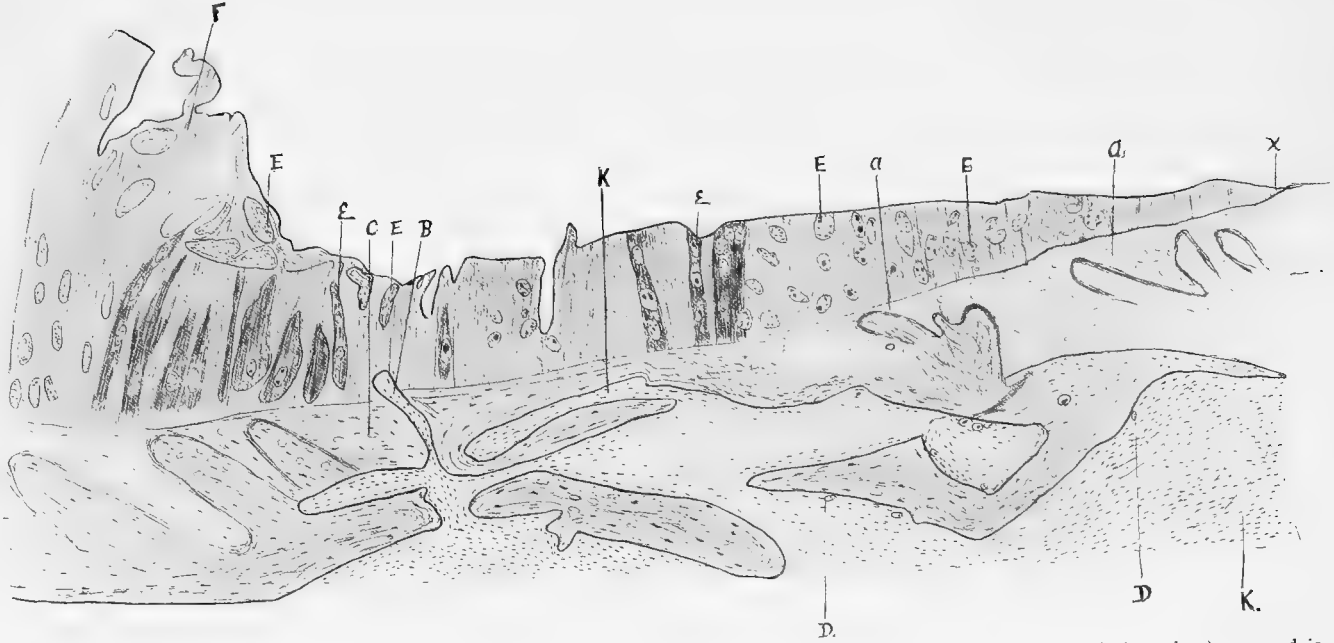

FIG. XIII. — Proximal extremity of the tibia, showing extensive osteo-porosis. A, Subchondral degenerated bone. D, Giant cells (osteoclasts), arranged in Howship's lacunæ. These are better demonstrated in Fig. XV. E, Cartilage cells atrophied and arranged in mother capsules. K, Marrow cavity completely filled with cells and vascular structures; a few of the cells were observed undergoing cell-division. E', Cartilage cells. X, Marginal line between bone and cartilage. F, Fibrillation of the articular cartilage. X, 50. Case V.

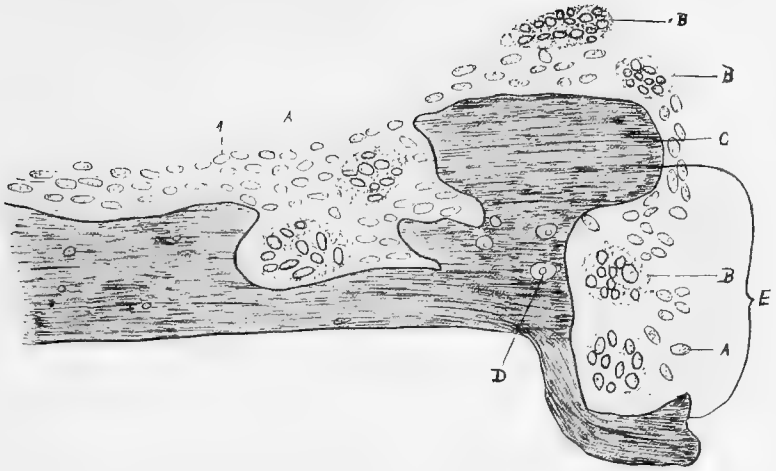

FIG. XIV. — Proximal extremity of the tibia, showing extensive osteo-porosis. A, Marrow cells. B, Osteoclasts (giant cells). C, Bone matrix. D, Lacunæ, in which canaliculi are absent, bone cell having undergone almost complete atrophy. E, Howship's lacunæ. This drawing is made from the same section as Fig. XIII, Case V. X, 450.

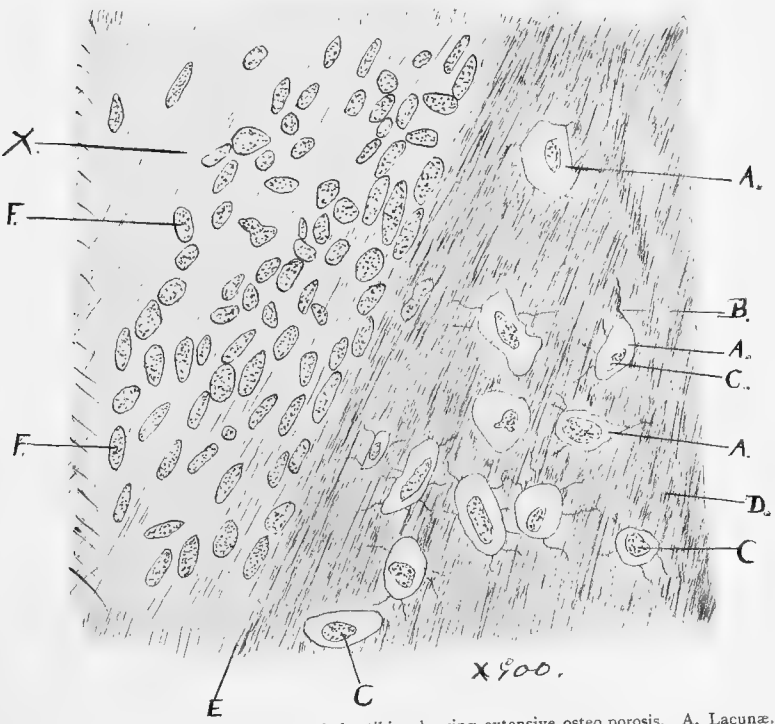

FIG. XV. — Proximal extremity of the tibia, showing extensive osteo porosis. A, Lacunæ. B, Canaliculi extensively atrophied. C, Bone cell. D, Bone matrix (trabeculæ). E, Line of contact between bone and marrow. F, Marrow cells. X, Marrow cavity; note similarity of C and F. X, 900.

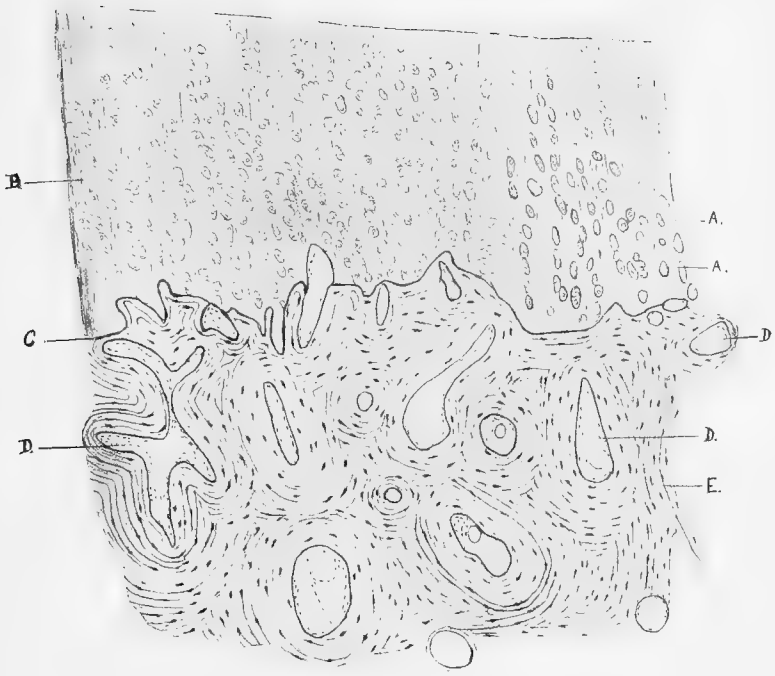

FIG. XVI. — Healthy scaphoid of horse; age 12 years. A, Cartilage cells. C, Boundary between articular cartilage and bone. D, Marrow. E, Tella ossea. X, 50.

A glance at the cartilage of this tibial bone shows that it was extensively diseased (Fig. XIII). The cells are arranged in mother capsules and variable in size; near the free surface of the cartilage they are greatly modified in structure and arrangement. In certain areas the cells are larger (Fig. XIII, E^1). The connective tissue between the cells is increased in amount and fibrous in character, while normal articular cartilage is of the hyaline variety. In places we find a metaplasia of the cartilage with splitting of its fibers, in other places the cartilage has entirely atrophied, bringing the abraded articular surfaces of the bones in direct contact.

The condition and appearance of the bone and marrow in this section offers a suggestion to the influence exerted by the giant cells (osteoclasts) upon bone resorption. This is the only case in which we have been able to demonstrate the presence of such cells in large numbers, only a few being observed in case IV. In case V, however, they were very abundant both in Howschip's lacunæ and in the center of the marrow cavities. Certain parts of the sections examined presented areas where no giant cells were visible, the marrow cavities were rich in a cellular structure, and the bone matrix presented marked indications of resorption. The lacunæ were misshapen or rounded, some were very much enlarged with irregular and poorly defined outlines, others abnormally small. The bone cells in such lacunæ were hypertrophied, atrophied, or absent. In the majority of cases noted they were present, enlarged, and granular in appearance, their position in the bone matrix alone, distinguishing them from neighboring marrow cells (Fig. XIV).

While it is generally believed that the osteoclasts exert a certain influence in bone resorption we have a case where it would seem that resorption was rapidly progressing in their absence (Fig XIV). It is difficult to understand just how the osteoclasts can bring about such marked changes in the bone cells that are deeply situated in the bone matrix; the idea suggests itself that the primary change begins in the individual cells themselves, those of the trabeculæ, as well as in those of the Haversian canals. As the bone tissue atrophies it is perfectly logical that the Haversian canals should become enlarged. Suppose in Fig. XIV, for example, that three or four of the bone corpuscles continue increasing in size until they occupy a common space, and that at the same time this breaks through into the

neighboring marrow cavity; such changes would result in the formation of a Howschip's lacuna.

SUMMARY. — This group of diseases is characterized by an inflammation of the bone, cartilage, and capsular ligament. The following changes are noted in the *bone:* hypertrophy of the marrow cavities, and atrophy of the osseous matrix. The marrow cells are greatly increased in numbers. The bone cells (corpuscles) become granular in appearance and smaller in size. The lacunæ are enlarged, and at the same time may lose their typical form. The canaliculi undergo partial or complete atrophy. The disease process seems to be operative throughout the whole extent of the affected area at the same time; that is, bone resorption is not confined to those portions of the osseous matrix with which the marrow cavities are in direct contact (osteomyolitis), but progresses just as rapidly within the interior of the compact bone (ostitis). These changes are found in the bone during the earlier and more active stages of the disease (osteo-porosis). They are demonstrated in figures XI, XII, XIII, and XIV. During this stage the bone is abnormally soft, porous, and light (osteo-porosis), later becoming more compact and heavier (osteo-sclerosis). The histological characteristics of osteo-sclerosis (condensing ostitis) are atrophy of the marrow cavities and hypertrophy of the bone matrix; the cellular structure of the marrow cavities becomes greatly increased in amount (Figs. XI and XIII). There is a cessation of the inflammatory process; and resorption of bone is replaced by a regeneration of the osseous structure. Many of the lacunæ, however, fail to regain their lost bone cells (Fig. X, d). The disease of the bone has been accurately termed: "Osteo-porosis succeeded by osteo-sclerosis" (Gotti, Bayer, Fröhner, Eberlein, etc.).

The characteristic changes in the *cartilage* are: fibrillation of the superficial layers, extending in some cases to the osseous tissue; hypertrophy of the intercellular matrix, as well as hypertrophy and proliferation of the cartilage cells; partial or complete atrophy of certain portions of the articular cartilage characterized in some cases by the formation of ulcer-like depressions (Figs. XII and XIII).

The *capsular ligament* presents the most pronounced changes in those articulations of which the knee joint is a type. In certain cases, especially in the earlier stages of the inflammation caused by this disease, the capsular ligament is distended with an

abundant serous exudate (serous arthritis); bluish-red discolorations of the serous membrane are observed. As the disease advances one finds connective tissue proliferations and osseous degeneration of the ligament (arthritis deformans). In many cases these degenerative proliferations become constricted at their points of attachment to the capsular ligament and drop into the articular cavity where they are found as free joint bodies (Case No. V, femoro-tibial articulation).

It will be seen that this disease has many lesions in common with arthritis deformans as described by Fröhner: "In human surgery deforming inflammation of the joints is a chronic, aseptic, senile arthritis (malum senale) which leads to severe and permanent changes in the entire joint. It is not characterized by suppuration; it may have a spontaneous or traumatic origin; is either mono- or polyarticular; its favorite seat is in the joints of the knee, hip, shoulder, and elbow, on the fingers, and in the vertebral column. It is a non-febrile arthritis that is ushered in with stiffness, crackling, and slight pain in the involved joint; usually continuing during the life of the individual, and finally leads to deformity of the entire joint. Anatomically it consists of degeneration and new formation processes of the cartilage, bone, and joint capsule.

"(*a*) In the articular cartilage one finds changes characteristic of arthritis ulcerosa sicca chronica; namely, fibrillation of the superficial layers, focus-like areas of fibrillation and softening of the deeper layers, ulceration, and even complete atrophy of the cartilage with the formation of smooth, polished surfaces. One also finds active proliferation of the cartilage in the form of nodular processes.

"(*b*) In the bone there exists a subchondral inflammatory osteo-porosis with atrophy of the lacunæ in addition to bony new formation.

"(*c*) The joint capsule shows proliferation, thickening, and wrinkling. One occasionally observes the formation of free joint bodies." (Bayer-Fröhner "Tierärztliche Chirurgie und Geburtshilfe Allgemeine Chirurgie," 1905.)

While this group of diseases, of which spavin is a type, bears a very close resemblance to arthritis chronica deformans, there are certain features that are not characteristic of the latter affection; namely, in the spavin group the changes in the first stages of the disease are confined largely to the bone (Fig. XII). In

arthritis deformans the cartilage is the primary seat of the principal changes. In view of these facts Professor Fröhner defines spavin as follows: "Spavin is principally an ostitis of the os magnum and medium as well as the metatarsus, from which there afterwards secondarily develops a deforming inflammation of the tarsal joint. It is more correct, therefore, to define spavin as an *osteo-arthritis chronica deformans.*" ("Allgemeine Chirurgie," 1905.) The same term is applied by this author to the changes which occur in ringbone, gonitis, omarthritis, etc. It is obvious that the lesions found in the preceding five cases are in accordance with Professor Fröhner's interpretation of the disease. It is further noted that, similar to arthritis chronica deformans in man: "it may have a spontaneous or traumatic origin." Further investigations may reveal that the influence of traumata, as direct causes of the disease, has been somewhat over-rated. In cases III and IV the existence of a spontaneous (pathological), indirect etiological factor seems to be fairly well demonstrated, being present in both a young and an old animal; many careful and widely distributed examinations are necessary to determine the extent of this influence.

The causes of "osteo-arthritis chronica deformans," when of "pathological" origin, lack complete and unobjectionable demonstration. Rachitis and rheumatism are doubtless operative in many cases of the disease when occurring in young animals; the latter may be a more important factor than is generally alleged ("Monatshefte für praktische Thierheilkunde," Vol. XV, page 211: "Rachitische Schale und rachitischer Stelzfuss beim Pferde:" Fröhner).

This pathological condition is not confined to young animals. The visible lesions may be confined to one or two bones and articulations, or be well distributed through those of the extremities.

Clinical examination may lead to diagnosis of lameness in the anterior limbs when a post-mortem examination of the same animal shows that the disease is more pronounced in the posterior limbs (Case III).

URINALYSIS.

The composition of the urine during this affection has not been fully investigated, nor have definite observations been made

regarding the volume or density of that excretion. We became interested in relation to the amount of phosphates occurring in the urine of animals affected with this disease as compared with those in apparent health, but failed to carry these investigations to a conclusive stage. The few data are highly suggestive, however, and should stimulate further study. The following table exhibits graphically the results of the few analyses made by Prof. Geo. W. Cavanaugh relative to the phosphoric acid (P_2O_5) in the urine.

Laboratory Number of Analysis	Condition of Animal	Phosphoric Acid per Liter of Urine
2,672	Slight double navicular disease	traces
2,673	Non-diagnosable shifting lameness (Rheumatism?)	no trace
2,674	Healthy farm horse	no trace
2,675	Healthy farm horse	no trace
2,676	Weanling colt with four active ringbones	4.55 grammes
2,677	Same patient after an interval of eleven days	3.76 grammes
2,678	Second sample from 2,673 (was being fed phosphates in large quantities)	.09 grammes
2,679	Second sample from 2,674 (was being fed phosphates in large quantities)	trace

These fragmentary records serve to indicate that during the active stages of ringbone and navicular disease an excess of phosphorus, presumably in the form of calcium phosphate, is present in the urine. It occurs only in traces in 2,672, the mare at that time having been under the best possible hygienic conditions as understood by us, and the presence of the malady barely recognizable in a short gait without limping.

In 2,676 and 2,677 the amounts of phosphates become very marked and stand out as distinctly pathological when compared with the other analyses. The case, a weanling filly, was suffering acutely with four active ringbones from which she recovered her general condition and now, after eight years observation, is working sound, the large ringbones being quiescent.

In sharp contrast to these are samples 2,673, 2,674, and 2,675, the first of which had a peculiar, intermittent lameness for a year or more, shifting from region to region without apparent cause, or without inducing any recognizable lesions in any part and ended by apparent recovery which has remained constant for eight years. Nos. 2,674 and 2,675 were healthy farm animals employed at regular farm work.

An interesting query is here raised upon which chemists seem to be at variance, some claiming that phosphates are not normally

excreted in the urine of the horse while others are insistent that it is so excreted in measureable quantity. It would appear that one of the great difficulties in the analysis of the urine of the horse is an attempt to apply the methods used in examining the urine of man, especially quick, approximate methods which yield reasonably accurate results, or rather estimates in human urine, and which may be in part or wholly invalidated by the widely dissimilar character of equine urine. Have the different investigators dealt with urine of essentially different composition? Was that urine which contained phosphates normal? In the foregoing we find in acute ringbone a maximum of 4.55 grammes of phosphoric acid (P_2O_5) equivalent to 10.18 grammes of calcium phosphate ($Ca_3(PO_4)_2$) and then meet with complete negation in normal work animals.

Another interesting feature is the effect of the feeding of large quantities of phosphates upon their excretion by the kidneys. After the animals from which samples 2,673 and 2,674 were taken had later been given two to three ounces daily of sodium phosphate in their food, the former showed .09 grammes of P_2O_5 per liter of urine or .02 of the quantity observed in 2,676, while the later, 2,674, showed only traces of phosphates. This would appear to suggest that the ingestion of an unusual amount of phosphates tends to establish or increase their presence in the urine, but only very slightly as related to the amount ingested, most of it evidently being excreted by the intestinal tract or other avenues of egress.

Urinalysis appears to be a most inviting field for the further study of this malady.

ETIOLOGY.

As most authors consider the entire group to be so many distinct affections, they attempt to elucidate separate causes in each instance, and in so doing have invoked for each, almost every conceivable form of mechanical insult and other injuries.

Confessing the identity of the lesions, wherever they may occur, we should admit a cosmopolitan reason for their existence, which would serve equally to explain spavin, navicular disease, fracture of the ribs, anchylosis of the vertebræ, or any other member of the group. As an illustration we might take the horse from which Figures XVII and XVIII are taken. Here

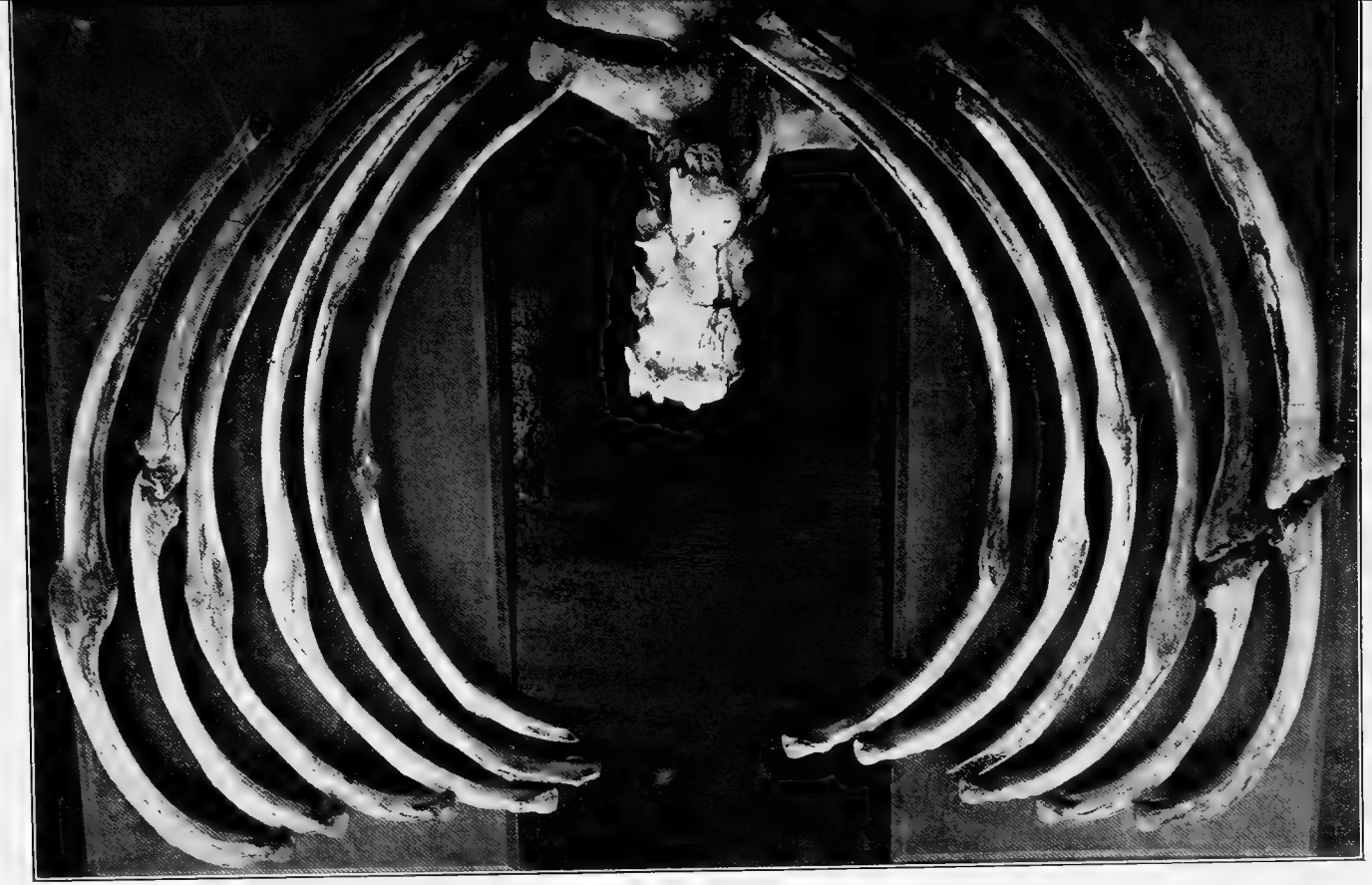

FIG. XVII.—Photograph showing fractured ribs and anchylosed dorso-lumbar vertebræ from same horse as Fig. XVII. Following contagious pneumonia (brustseuche), the patient had severe tendo-vaginitis at both anterior fetlocks, sesamoiditis, ringbones, navicular disease, sidebones, etc., along with the spontaneous fracture of ribs, and anchylosis of and exostoses upon the dorsal and lumbar vertebræ.

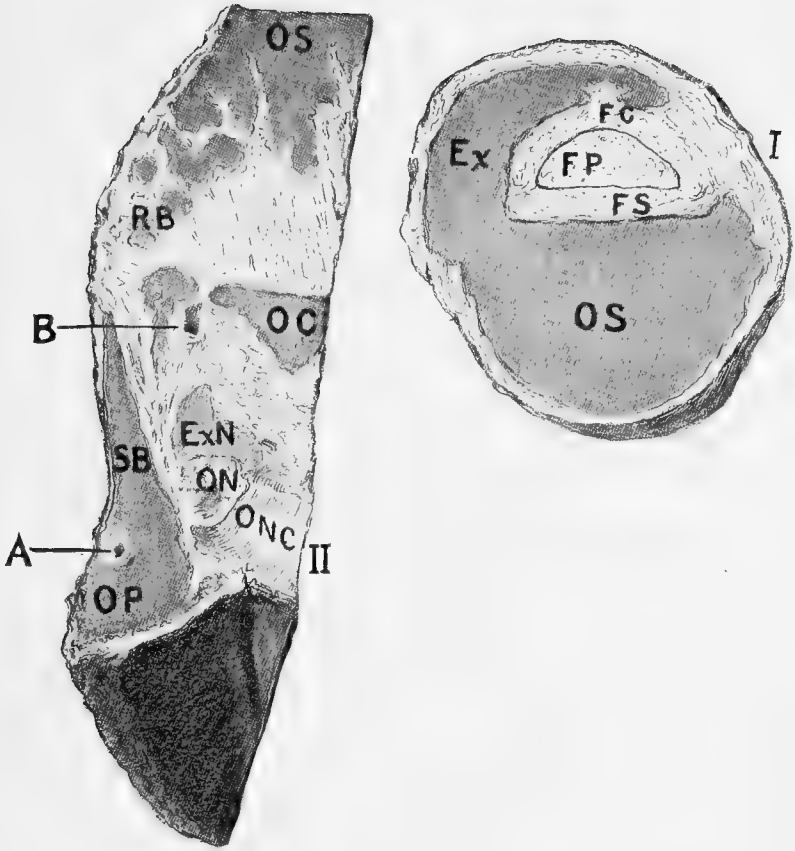

FIG. XVIII. — Sections of foot from the same case as Fig. XVII.

I. Cross section of os suffraginis near its superior end.
O. S., Os suffraginis.
Ex., Exostosis on os suffraginis (ringbone), tending to envelop the three flexor tendons.
F. C., Flexor of the coronæ. F. P., Flexor of the os pedis. F. S., Flexor of the suffraginis (suspensory ligament).

II. Longitudinal section of the left half of fore foot. O. S., Os suffraginis. R. B., Ringbone on os suffraginis. O. C., Os corona. S. B., Sidebone. Ex.N., Exostosis on navicular bone. O. N., Navicular bone. O. N. C., Articular cartilage of navicular bone. O. P., Os pedis. A. and B., Arteries.

we have shown ringbone, sidebones, navicular disease, sesamoiditis, vertebral anchylosis, and thirteen broken ribs. Although no detailed autopsy was made and the diseased parts noted were only incidentally discovered while examining for tendonitis and tendo-vaginitis, it is fair to assume that other parts of the skeleton were similarly involved. It would be absurd in this case to refer the sidebones to concussion from the shoe heels, the navicular disease to shoeing with too low a heel, the ringbones to strain of the lateral ligaments, the sesamoiditis to concussion, the tendonitis to strain, the spinal anchylosis to unobserved slipping in the stall and the thirteen fractures of ribs to as many blows from a rough groom or horseshoer. Coming simultaneously as these did, and maturing within a few weeks without the action of any of the foregoing causes, so far as can be determined, we are forced to look for a cause which will afford as good an explanation for the broken ribs as for the navicular disease.

The alleged causes of the different members of this group of affections are so numerous and varied that we cannot fully consider each in its relation to the etiology of others, but must rather content ourselves with a brief study of the relation of those factors indicated as the essential element in the etiology of one member of the group to the causation of the others; that is, we desire to study the etiology of the group as a group and not become misled by what may appear as essential causes in one member which could not have any influence upon another.

The principal cause assigned by veterinarians for this affection is traumatism, rarely some constitutional disease of the bony skeleton or of the general system, and occasionally heredity is charged with a very important rôle.

STRAIN. Among the trauma, strain holds perhaps the first place as an alleged cause of this disease, and this form of traumatism being generally considered so common and universal renders it a very convenient and ever-present means of explanation.

In order to fully consider this allegation, we need first to study the mechanism of the limbs of the horse, the parts most frequently and most evidently affected, and learn how far the ligaments of these articulations are subject to injury as a result of over extension in the direction of their fibers; and secondly, to inquire what actual evidence can be adduced as to the fre-

quency and extent of these injuries. Were the question propounded, in what two animals are strains most common; doubtless the uniform answer would be, man and horse, some placing the one, some the other, first. Carefully examined comparatively, they represent the extremes in anatomical structure and attitude among the higher mammalia.

Comparing the thoracic limbs of the two, we find in man a member adapted for the prehension and holding of objects, for climbing and for more or less suspending the body; while in the horse it is used essentially for weight bearing, supporting fifty-five per cent. of the body weight, and plays a fundamental part in the process of locomotion. In man it is rigidly attached to the thorax by means of the clavicle, while its sole attachment in the horse is by means of powerful and elastic muscles, with the heavy skin covering, which permits extensive movements of the member upon the chest.

The scapulo-humeral articulation of man, with the support of the clavicle, stands out prominently from the thorax with the humerus free and the joint so formed that a very extensive area of motion, representing a hemisphere, is permitted. In the horse, on the other hand, the extensive flattened contour of the scapulo-humeral region with the angle existing between the two bones closely applied against the chest walls, prohibits in a large degree rotation, adduction, and abduction, and limits its movements in health chiefly to antero-posterior flexion and extension, so that direct strain upon the ligaments, originating in the humerus itself, is practically prohibited, while strain upon the joint transmitted through the radius is usually nullified by the free movement of the shoulder on the chest wall or by closure of the scapulo-humeral angle, each of which safeguards are denied to man.

As a result of the formation of the shoulder man suffers rather frequently from severe strain or dislocation of that joint or fracture of the clavicle from violent impact on the humerus, while in the horse these accidents are rarely diagnosable, the dislocation of the scapulo-humeral articulation occurring so rarely that few practitioners see cases. Since dislocation must always constitute the finality of the strain of articular ligaments, its frequency serves as an index of the occurrence of the latter.

Examining the limb as a whole, we find that in man it is capable of extension in a straight line from end to end, resulting

in defective elasticity unless specially posed, while in the horse the long axis of the limb describes great alternating angles, the scapulo-humeral opening backwards, the humero-radial forwards, and the phalanges extending obliquely downwards and forwards from the metacarpus. When a horse places its weight upon the end of the last phalanx, the smallest base of support seen in any mammal, the very narrowness of that support, combined with the angles in the limb and especially the obliquity of the pastern, serves to almost entirely prohibit lateral impact, and any violence tends rather to decrease the angles and shorten the limb. As a result dislocation and strain are well-nigh unknown, and the lateral articular ligaments in the horse are comparatively small except in the scapulo-humeral articulation, where passive ligaments are replaced by powerful muscles which permit of a considerable normal displacement of the articulation without injury. It thus occurs that lateral or median luxation in its ordinary meaning almost never takes place anywhere in the anterior limb of the horse whereas it is comparatively frequent in the arm of man, not an articulation escaping.

The mechanism to prevent antero-posterior luxation in the horse is highly developed, the powerful biceps assumes the rôle of a great musculo-tendinous band to retain the scapulo-humeral articulation in front while the anconean group of muscles prevents the sufficient opening of the angle behind to admit of posterior luxation and at the same time the two muscles guard, in a reverse manner, the humero-radical articulation. Beyond these, the great flexor muscles and their powerful tendons serve as elastic supports upon which the articulations rest securely behind with little need for posterior ligaments and with the weight ever inclining backwards upon these tendons to such a degree that almost no provision is required against anterior displacement, or anterior strain.

In man, on the other hand, the great freedom of movement in every direction, including rotation, submits each and every joint to overtension of its ligaments. They may become strained or may rupture and luxation follow, or the ligaments may prove too resistant and the bones become fractured. Anatomically strains and luxations and fractures resulting therefrom should be common in man and very rare in the horse. Clinically we observe these quite commonly in the thoracic limb of man and abundant strains which do not end in luxation or fracture, but are

clearly diagnosable as strain by immediate pain in the part followed by rapid inflammation, which tends finally to subside after rest, with thickening and weakening of the ligaments, and without exostosis or ostitis.

In the anterior limb of the horse, the guardianship of the great flexor tendons over the articulations is well shown by the frequent strain or rupture of these structures, whereas in man, the feebly developed corresponding parts rarely suffer injury, which is instead borne by the bones and articulations.

Upon examining the pelvic limb we observe an equally pronounced contrast in anatomical arrangement as related to strain so far as it is borne by the joints and bones or by the great musculo-tendonous apparatus.

In man the femur continues the spinal column in an approximately direct line, while in the horse it is directed abruptly forwards upon a horizontal spinal column, forming an angle opening forward, at once reversed at the knee where the femur and tibia are on a direct line in man. The great angle of the tarsus opening forward in the horse is highly efficient in warding off lateral strain, while in man it is lost by the tarsus coming in contact with the ground. The entire limb of man is practically direct from the hip to the ground, and supports above the upright spinal column, so that any violence of movement falls directly upon an unyielding, erect column, the bones and ligaments of which must suffer, while in the horse the great angles of the limb effectively ward off strain and throw it from the bony column upon the powerful musculo-tendonous apparatus which receives the shock and records the consequences in strains and ruptures of the great flexor tendons. (In this comparison we view as a tendon the so-called suspensory ligament of the fetlock, which contains muscle fibers, represents an active muscle in man, and is described as a muscle in the horse by various anatomists, especially the Germans, and properly belongs with the great flexor tendons whose functions and injuries it shares.)

We must therefore conclude that both anatomically and clinically man is preëminently disposed to strains and their finality, luxations, or fractures, while in the horse the impact of transmitted violence falls upon the musculo-tendonous apparatus.

We rarely see a luxation or dislocation from a strain in the limb of a horse except the foot becomes caught in a tramway or similarly firm place. Without anatomical evidence of liability

of strain or clinical proof of its frequent occurrence, we are compelled to conclude that strain bears but a secondary part in the etiology of this group of affections.

CONCUSSION. Concussion is so closely related to strain, it is the sudden impact of one body against another in a manner which tends to crush the weaker of the opposing bodies, rather than to divide it by fracture or rupture, that we might define it as the same force acting in a different direction. The effect of concussion depends largely upon the resiliency of the surface of contact and the facility by which it may glide away from the concussing force. The articular ends of the long bones and the entire short bones are cancellated and elastic and the angular direction at which the bones of the extremities meet in a horse, as already described, admit of their ready recoil in obedience to concussion.

The disease does not most frequently attack those bones most subject to concussion, nor at the points where concussion is apparently the greatest. We observe the navicular bone swinging in the hammock-like tendon more frequently seriously attacked than the adjoining pedal bone, which certainly receives by far the greater concussion; but more interesting is the fact that the plantar surface of the navicular bone is universally the portion most obviously affected, whereas if concussion caused it, the chief pathologic changes should be found on the dorsal surface which, so far as we know, always escapes. In ringbone concussion plays no very evident part. In horses with exceedingly oblique pasterns, the disease is probably as common as in those with upright pasterns and certainly more recalcitrant to all attempts at cure, yet the obliquity of the pastern obviates concussion and supplants it with strain on the tendons.

In spavin it is difficult to see how there can be greater concussion between the lesser bones of the tarsus and the metatarsus than between the astragalus and tibia, yet the former constantly suffers and the latter only very rarely.

Some have suggested that the anchylosis of spavin is a process of evolution tending ultimately to efface the latter joints, but the tendency is seen only in diseased animals which, if the contention were true, would tend to show that it is a pathologic evolution.

Gonitis can scarcely be regarded as the result of concussion as the parts usually affected are those most widely propped apart

by means of the fibro-cartilaginous discs. Throughout the entire group, it cannot be well charged that concussion plays a fundamentally essential rôle in the causation of the malady.

It is instructive also to study the frequency of this group of affections in those animals where concussion and strain are most common and violent compared with those whose environment protects them most completely from these injuries.

Were we to single out the horse amongst all others which is most subject to strain and concussion, we would probably select the fire department animal, whose work is on a hard pavement, before a heavy load, starting suddenly at a run under the whip and continuing at high speed until reaching the destination, or stopping from exhaustion. This horse may split the hoofs, rupture the tendons, or break the bones, but is probably about the freest horse in existence from ringbone, spavin, and navicular disease.

Or let us take the cow horse of the west, bearing a saddle of seventy-five pounds and a rider of two hundred pounds during a long and trying day, a large part of the time at a brisk gallop, over bank and coulee, badger holes and prairie dog towns, over stones and through morass, dodging an enraged animal, darting here and there in pursuit of fleeing stock and, when the lariat is thrown, the horse must suddenly stop to bring his quarry to the ground and then be keenly alert to hold it.

Such animals break their legs or necks, but rarely suffer from ringbone, spavin, or navicular disease. We might enlarge further and it would be found that those animals put to hard, trying work, constant in character, are not the ones to suffer from these affections, though admittedly suffering much from strain and concussion. On the other hand, we have seen foals less than six months old which had been born in a box stall and had never been allowed the pleasure of a frolic, to show four large ringbones and two well-marked spavins.

It is a well-known fact that horses used intermittently, or horses doing light delivery work, but kept all day long in the harness standing tied to a post, like peddler's horses and delivery horses belonging to small concerns, suffer very seriously, as do also the cheaper class of private horses and children's ponies, which are only occasionally used as opportunity or caprice of the owner may dictate. It is *very* common also in those pet horses which are driven very sparingly and infrequently or rarely.

Again it is to be noted that horses suffering from severe

strain or violence to a limb do not as a rule develop this affection in the injured member, but while standing upon the other legs, develops the disease in them, or, perhaps more closely related to this group than we have yet admitted, the well foot suffers in time from sinking of the os pedis, which Dollar translates in his version of Möller as "standing laminitis."

Regardless of the contention that the strain causes the ringbone, navicular disease, spavin, or other similar ailment on the supporting limb, it certainly should be more likely to occur in the injured member as the result of the greater strain which caused the original disaster.

Faulty Shoeing. Improper shoeing has been blamed for well-nigh all the ills to which horse is heir and has fairly won enough opprobrium.

Its effect in inducing this malady should be viewed carefully. We all fully realize that careful shoeing, pathological shoeing as we sometimes term it, definitely alleviates some cases of ringbone, spavin, or navicular disease, and we may well deduce therefrom that improper shoeing has a definite relation to the cause, but whether its influence is fundamental or contributory, perhaps we will not all agree. Since all stabled horses are shod and most horses affected with this disease are stabled, it is very easy to blame the shoeing, and since the feeling existing between the average practitioner and shoer is frequently not very cordial, it is easy to place the blame on the latter.

We have no data to show that barefooted horses, when kept under the same conditions, suffer any less than those which are shod. We would not have it understood that we think shoeing exerts no influence, but that the relation is contributory or secondary and we shall recur to this influence later.

Compression from Tendons. The idea of Dieckerhoff that spavin is due to a tendo-vaginitis of the cunean division of the flexor metatarsi tendon is supported by the curative results frequently obtained by cunean tenotomy, but the deduction cannot be extended to most other members of the group. The argument is perhaps equally good in reference to navicular disease. But the influence of the compression of tendons is so limited in its scope that it cannot be relied upon as an essential etiological factor. We believe, however, and to that extent agree with Dieckerhoff, that it does play a very important secondary rôle in the two affections noted, and shall deal further with this question below.

Contraction of the Hoof. The contraction of the hoof has only been alleged to act in relation to one or, perhaps, two of the maladies, navicular disease and sidebones, and hence loses much of its interest to us in considering the etiology of the group.

Even in the specified maladies the question is one of animated controversy, some urging its causative importance, others denying it wholly and assigning it a position of effect instead. Certain it is that chronic navicular lameness is accompanied by contraction, but it is difficult to show that it causes the affection, if we look upon navicular disease as a separate malady. When considering navicular disease as one member of a great group, contraction and dryness of the hoof must be reckoned as a contributory or modifying cause rather than essential.

Labor. Confinement. The character of the labor or degree of confinement apparently exerts a profound influence upon the development of the affection. We have already referred to this in considering the influence of strain and concussion. In general, it may be stated as a rule that those animals are most free from these affections which are either regularly worked, whether moderately or severely, or enjoy the constant freedom of the open range or pasture, and that those are most vulnerable which are closely confined and kept in enforced idleness, worked intermittently, or put at work where they are driven but a brief time each day and kept standing hitched in a vehicle during long hours.

In the free clinic of the New York State Veterinary College, where many of these observations have been made, it is found that numerous cases occur during April, May, and June. The farm animals in this community have little or no work during the winter months, and are generally kept closely stabled without exercise, on a limited diet of oats and hay, and, soon after being put to work in the spring, develop lameness, due to some member or members of this group. How confinement may act prejudicially we do not know, but the clinical evidence of its influence is strong. The horse is preëminently an animal of action, and any severe restriction tends to lower his power of resistance to disease. This group of affections is generally considered the special heritage of city horses, which are constantly subjected to stabling, shoeing, and working on hard streets

We have already pointed out that shoeing cannot influence the whole group, but only a few members, and paved streets can scarcely occupy an essential place, or the disease could not be abundant in country places. In the vicinity of the New York State Veterinary College the disease among farm horses is so prevalent as to give it the proportions of an enzoötic of serious import, but there are no paved roads to act as a causative factor.

CLIMATE. The effect of climate has not been well studied, but it is known that this group of affections have rather interesting geographical limitations, but whether this is due directly to the effect of the climate upon the horse, or whether it is rather indirect through the food and the necessity for stabling has not been definitely ascertained; but, so far as observed, its influence is indirect. The affection is most common in the eastern United States, and in the great cities of the middle states; it is comparatively rare in the agricultural districts of the Mississippi valley, and becomes more rare as the Rocky Mountains are approached, where over large areas it is practically unknown, to become more common again on the Pacific slope.

Various explanations may be offered. The horse normally belongs to high, arid or semi-arid plateaus with dry soil and not very abundant vegetation of a high nutritive value and free from fungi, which conditions are attained in those regions where the disease is most rare. We must at the same time note that in these regions the horse enjoys the greatest liberty and is little confined in stables; it is, moreover, the newest part of our country. The senior contributor has noted an apparent increase of this malady in central Illinois as the country becomes older and the soil and crops have undergone changes as the outcome of continued cultivation.

FOOD. A restricted diet constituting an unbalanced food ratio induces serious perversions of nutrition, among which we meet with experimental rhachitis, wherein a condition of the bony skeleton is induced which is not distinguishable from the changes taking place in this group of lamenesses. Pigs fed upon an exclusive diet of corn meal and confined closely so as to limit them strictly to the diet given, soon succumb to rickets. A similar condition is seen in horses fed exclusively on bran. Hinebauch presented a highly interesting paper at our thirtieth annual meeting (Proceedings of U. S. V. M. A.,

1893, p. 103) under the title of "Millet Disease in Horses," in which, by feeding millet to horses in North Dakota, mostly in close confinement, serious losses were induced, with symptoms and pathologic conditions not separable from rhachitis.

Food must, in our judgment, be regarded as playing a highly essential rôle, though in just what manner we cannot assert, nor can we wholly separate the question of food from that of climate and housing.

At times it appears that the food acts directly and constitutes in itself a sufficient cause. We (W.) saw, in Montana, in one case some twenty-five or more foals, all showing signs of rhachitic affection in the form of spavins, ringbones, etc. They were confined on a marshy, alkaline "bottom" pasture, where the grass was of a coarse variety. The following year the next foal crop, from the same parents, were pastured on high foot-hills, and the disease did not recur.

HEREDITY. The spavin group of lamenesses are generally said to be hereditary. Sires and dams so affected, whether lame or not, and regardless as to whether they ever have been lame or not, are excluded from the show ring as breeding stock on the ground of hereditary unsoundness.

Under the head of climate we have already roughly outlined the geographical distribution of the malady, it being practically enzoötic in one section and well-nigh unknown in another, though the ancestry of the animals in the two localities is as nearly identical as can well be. This speaks strongly against heredity. On the other hand, in those parts of the country where the affection is common, a diseased mare may raise a series of colts, all affected and for generation after generation the disease may continue in a given line and on a given farm, but we should remember two possibilities, the breeding and the farm. If given environments on a breeding farm can cause spavin in a mare, there is no known reason why the same conditions should not produce the same state in her progeny and in theirs, generation after generation. When discussing the question of food, we related the case of one ranch where this affection prevailed when foals were confined in a given pasture, but disappeared when the mares were moved to a different character of grazing land. Among the foals of a previous season from this same farm, was a vigorous, highly bred stallion with two enormous spavins on otherwise excellent legs. This animal

was used for stud purposes on a near-by farm on an excellent band of roadster mares, where for years he bred choice stock, none of which, we are assured, showed any tendency to spavin or other affection of the group. Dr. Fisher contributes an observation on a California breeding ranch where a number of foals were confined in paddocks and highly fed. Osteo-porosis became general, some perished, the remainder were then removed to a hillside pasture one-half mile distant, where they promptly recovered.

The only clinical evidence of heredity which we have been able to observe is the occurrences of the disease among offspring under the same conditions as those which produced it in the affected parent, while affected animals removed from the surroundings in which they acquired the malady do not transmit it to their offspring. We hold that a hereditary disease is cosmopolitan, knows no geographical limitations, and is not overcome by such environments as climate, food, or housing, and, taking this view, we cannot admit heredity as a cause of spavin or its allies.

We believe, however, that hereditary peculiarities in conformation may tend to predetermine, in case the disease does arise, whether it shall appear in the form of spavin, ringbone, or other affection.

Rheumatism. It is exceedingly difficult to arrive at any definite conclusion as to the rôle played in the causation of this group of affections by the oft alleged rheumatism. The fundamental difficulty in arriving at a conclusion is the insecurity of our definition of the term, we having as yet determined no rheumatism lesion which can serve to clearly distinguish that affection, whether in man or animals, while in the disease under consideration we have lesions of quite a definite character, not capable of differentiation among possibly two or three different maladies, it is true, but by no means suggestive of rheumatism as described in man.

If we attempt to draw our conclusions from the disease known as rheumatism in man, the symptomatology is very unlike. We have occasional shifting of lameness in a few cases, it is true, but, as a rule, it is in a way permanent in the affected part, and, while rheumatism in man is ordinarily sudden in its onset, spavin and its allies generally come on insidiously, and only rarely appear suddenly. It seems to us that we are not

warranted at present in arriving at the conclusion that rheumatism plays any important part etiologically.

CONTAGIOUS PNEUMONIA (*Brustseuche*). Dieckerhoff has observed the frequent occurrence of spavin following convalescence after contagious pneumonia. This is a common observation and applies quite as fully to other members of the group. As already related, the horse from which Figs. XVII, XVIII, VIII, and IX were taken, after having apparently become convalescent from contagious pneumonia, quickly developed tendonitis and tendo-vaginitis, on which account he was destroyed, when beneath these swellings were found ringbone, sidebones, navicular disease, and sesamoiditis, and, upon opening the chest, thirteen fractured ribs and anchylosis of the vertebræ were revealed. Probably other contagious fevers of the horse tend to usher in this group of lamenesses, and certainly we know that any injury which may confine a horse in the stable for a long period, especially if the general system is markedly depressed, is very liable to finally end in an attack of this malady.

So far as we know, the contagious pneumonia or other affection has no immediate relation or, rather, it does not constitute an expression of the former, but by its debilitating influence prepares the way for spavin and its allies.

RHACHITIS, OSTEO-POROSIS, OSTEO-MALACIE. In the affection or affections variously described as osteo-porosis, osteo-malacie, and rickets, we meet frequently with spavins, ringbones, gonitis, etc., which are not distinguishable during life from the ordinary affection ascribed to other causes. In our paper presented to this association ("Rhachitis." Proceedings of U. S. V. M. A., 1891, page 113), we cited cases in which enormous spavins developed during a well-marked attack of osteo-porosis, that in the same stable nearly all weanlings died from typical rhachitis, some of them suffering from spontaneous fracture of the spinal column, while some older colts suffered from lordosis, kyphosis, or skoliosis. When spavin and its allies occur during rickets, osteo-porosis, or osteo-malacie, it appears to be an essential part of the malady itself, not a result of it. Our knowledge of the relationship existing between osteo-malacie, osteo-porosis, and rhachitis has not been determined; some believe they are identical, others consider them different, but fail to fix the boundaries between them or establish definite rules for differentiation. Prominent members of this society have time and again urged

the special study of osteo-porosis, but to no avail. If that one malady, if it be separable from the others, could be definitely described and differentiated from other diseases, it would be a great help. In the present state of our knowledge, we can only say that spavin and its allies appears frequently as a manifestation of this disease or group of diseases.

A Rarefying Ostitis, not at Present Identifiable with either of the Preceding. We regret possibly adding to the confusion by calling special attention to a form of disease expressing itself preëminently as spavin or its allies.

It occurs in the form of a rarefying ostitis affecting most visibly the short bones like the phalanges, navicular and sesamoids, and the lesser bones of the tarsus and carpus, producing the characteristic lesions already described. The indefiniteness of the preceding affections renders it difficult to place this one. It presumably belongs among the three, but whether to call it osteo-malacie, rhachitis, or osteo-porosis, we are at a loss to state. Either name might well be applied etymologically, since it affects the spinal column, and hence may be called rhachitis; the bone is softened, rendering the term osteo-malacie appropriate, and the bone is abnormally porous, which permits the designation of osteo-porosis. In the area of our chief observations of this disease, the neighborhood of Ithaca, New York, the affection is very common, has no limitations as to age, sex, or breed. It appears frequently in the form of ringbones and spavins in foals of three or four months, and is very common during the first winter of the foal's life. It is not at all rare to see such a foal with two spavins and four ringbones; with adult horses, on the other hand, the exostoses are usually not so symmetrical and universal. In some cases there is but one discoverable exostosis during life, and between this and cases where a sound joint does not seem to exist, but where the lesions are only discoverable upon post-mortem examination after cleaning the bones, there is every gradation.

In severe cases there are constitutional disturbances of a marked character expressed by a general appearance of bad health, and, among other things, an excess of phosphates in the urine.

In the region mentioned, typical osteo-porosis, with the enormous bulging of the facial and cranial bones, is wholly unknown. In nine years there has not been a case typical of

osteo-porosis presented at the clinic of the New York State Veterinary College, while spavin and its allies easily takes first place numerically among all diseases of the horse, whether medical or surgical, contagious or sporadic, but those animals presented *because of* this malady by no means represents the sum total of animals presented *with* it for other ailments. Normally, only those cases which are lame are presented because of the affection, but probably not more than twenty per cent. of the affected are lame, a large proportion of them apparently escaping lameness throughout their lives. We must leave the identification of this malady for further study, with the hope that the important group of diseases, expressed chiefly by a rarefying ostitis or porous and softened condition of the bones, possibly accompanied in all forms by phosphaturia, either be definitely identified as a single disorder or clearly separated from each other in a manner as to permit of a safe differential diagnosis.

INFECTION. Over and above all causes suggested stands the question of infection, one which is quite unanswerable from the data at hand.

Clinically such an explanation is not rendered impossible, and some investigators claim an infection as the fundamental cause.

FACTORS IN THE LOCALIZATION OF THE LESIONS.

If the disease, as we have already ventured to say, is fundamentally a constitutional and not a local one, it remains for us to consider the causes for the concentration in one or more small areas of the visible indications of the malady as expressed in exostosis, lameness, or other abnormality.

In discussing the causes of the malady, we have taken occasion to state that in our opinion many of the alleged chief causes were contributory or modifying rather than essential, since in our view they tend to determine the location of the pronounced symptoms of the disease, after the essential constitutional disturbances have become established either visibly or invisibly. We believe also that mechanical insult, either direct or indirect, may act as the sole means of developing the visible signs of the disease, which might otherwise disappear by resolution. We are not in a position to deny the possibility of

inducing the local lesions as a definite and essential result of a traumatic injury, but cannot admit that a mechanical insult at one point can induce general histologic lesions throughout the bony skeleton and induce serious pathologic changes in the urinary secretions. It has not yet been determined if a spavin, ringbone, or other local lesion ever exists in the active or formative stage without a generalized pathologic condition of the skeleton and changes in the urine. Granting the existence of constitutional disease, the factors which determine the localization appear to be largely capable of explanation.

Referring to the preceding chapter on pathology, it appears that the bones most affected are those which we commonly know as "short," and that the chief destruction takes place within the lacunæ and red marrow, which forms so large a portion of these and of the articular ends of the long bones. Thus we find the chief expression of the malady in the digits, navicular bone, the lesser carpal and tarsal bones, the spinal column, and the ribs. But we would not be understood that compact bony tissue does not undergo equally important changes in proportion to its comparative amount of active elements, as is shown by their decreased specific gravity and by their fragility as seen in fractures in these cases. The short, spongy bones become the chief points of attack because they contain a preponderance of the tissues in which the disease works its greatest havoc.

We may consider the varieties of mechanical insult under three heads: compression, strain, and concussion, and believe we have related them in approximately their order of importance. The horse is preëminently an animal of motion, but when not in locomotion maintains the standing position rather than recumbency in a very remarkable degree in comparison with other mammals. Some horses habitually stand while sleeping and do not lie down during long periods of time, while many horses which are kept in the harness long hours daily are compelled to stand a large part of the time, closely tied in an uncomfortable position between the thills of a wagon, where little opportunity for restful changes of attitude is allowed, even the head being fixed by tight reining. This brings constant pressure to bear upon certain articulations and the bones concerned. If we study the anatomical arrangement of the navicular bone, we find it being constantly compressed, whenever weight is borne upon the limb, between the unyielding

second and third phalanges above and in front, and the tightly stretched flexor pedis tendon behind and below. The compression may be varied somewhat on the superior surface and shifted from one articular facet to the other by changing the relation of the coronal and pedal bones, but, so long as weight is borne, the pressure on the inferior or tendonous surface is constant and unchangeable. The superior surface of the bone remains apparently normal as a rule, while the inferior face undergoes serious changes in which the tendon also shares. The anatomical relation of the navicular bone is alike in front and behind, but a horse bears approximately fifty-five per cent. of his weight upon his anterior limbs, and the burden is so great that normally both feet share it constantly in the same degree, while in the hind feet the weight-bearing demand, when standing, is unimportant and the limbs are alternately rested. The anterior navicular bones suffer often and severely, those of the posterior limbs almost never. Some say that strain or concussion plays the greater rôle here, but the strain is certainly greater during locomotion in the hind than the fore foot, and the concussion is far less in the navicular than in other neighboring bones.

In ringbone the occurrence of the affection most frequently in front is again quite as suggestive of compression as of concussion or strain, though admittedly the two latter play a far greater rôle here than in navicular disease.

In spavin we find the disease affecting with greatest frequency those bones which are under the most constant compression. The tendo-achilles behind, the flexor metatarsi in front, by their tension when the foot is at rest permit little relief from the compression of the cuneiform bones between the head of the metatarsus and the astragalus. When weight is placed upon the limb, the compression of these bones continues. To add to this, acute pressure is brought to bear upon the seat of spavin by the crossing over it of the tightly stretched cunean tendon. The theory of Dieckerhoff, allotting to this stretched tendon an important rôle in the causation of spavin, though we regard it as secondary, is in our judgment thoroughly justified, and the relief from spavin lameness secured by cunean tenotomy adds weight to the theory.

The belief in the importance of compression is further supported by the alleviation of spavin, ringbone, and especially

navicular disease by so shoeing the animal as to relieve the painfully affected parts from compression. One of our most useful diagnostic agents in spavin, *the spavin test,* consists of exalted pain brought about by unusual compression. We probably all recognize the evil influence of the *low heel and long toe* in determining navicular disease, and regard neglect in the changing of shoes and proper shortening of the toes as a highly important factor, and its significance to us is found in the increased compression of the navicular bone by the vicious position of the foot. In the same way we regard unnatural *dryness of the hoof* as acting injuriously through the compression of the bony structures included within it. We meet with strong proof of the importance of pressure as a causative force, when, after neurotomy, the natural protection of the diseased parts through the agency of pain is destroyed, the consequent pressure resulting often in increased virulence of the rarefying ostitis, leading to destruction of the integrity of the bones, ending in "breaking down." Compression probably acts chiefly by disturbing the circulation and causing congestion, and accelerating in this way the pathological changes occurring, especially necrosis and atrophy of the tissues.

Strain appears to play an important part in localization. We have noted, in several cases, especially in old-standing, quiescent spavins, a sudden eruption of lameness dating from becoming cast in the stall or from overexertion in drawing a heavy load. Perhaps this was due to a fracture or interruption between two more or less anchylosed bones. In other instances the exostoses have not been observed until shortly after a severe strain, but these cases with a definite history of strain constitute the exception and not the rule. Probably the great influence of strain in localization is due to overtension of a degree which would be counted normal under proper conditions, and acquire importance only because the tissues are weakened by disease. We might say it is the result of an attempt of a part to perform its normal function when unfitted by existing disease.

The same may be said of concussion. In some cases we meet with concussion fractures, inducing sudden and extreme lameness as in fracture of the navicular bone where it has been weakened, as shown in Fig. I, or splitting of the first or second phalanx, injuries which may occur as the result of extreme violence, but most generally seen in animals suffering from some osseous disease.

The part, consequently, which concussion plays in the localization of the disease, is probably considerable and of the same general character as the influence of strain; that is, the part is damaged by the concussion, not because the latter is extraordinary, but as a result of decreased power of resistance in the bone as a result of disease.

The *breed of the animal* fixes in a measure the *character of the labor* and the two factors acting through the preceding causes, apparently influence the localization. Draft breeds are rarely kept confined in the standing position so long as smaller horses, nor are they kept confined in stables for so long periods, their work being more constant. They do not suffer so much from navicular disease, probably because this bone is not subjected to so much abnormal, continued compression. But here we are frequently deceived by navicular disease being hidden beneath ringbone or sidebones, so that it is not diagnosed. Perhaps another reason acts in these cases. Draft horses have flat feet, and if the navicular bones become painful from disease and the horse attempts to relieve the compression, the pedal bone may move backward and downward and sinking of the os pedis result instead of, or along with the navicular disease.

On the other hand, strain and concussion play a more important part in the draft horse, and we see comparatively more frequently those forms of the disease most readily chargeable to these factors.

The conformation of the limb by which the compression, strain, or concussion is modified in a given part influences the localization of the disease. If a hock be faulty and other articulations good, we should expect that fact to tend to determine the disease assuming the character of spavin in preference to other forms.

THE CAUSES OF LAMENESS.

This group of diseases is so often accompanied by lameness and so frequently not that it is desirable to know upon what conditions it depends, since upon our judgment in this matter rests the value of our opinion as to the prognosis and the probable usefulness of the patient.

So far as we know, when the subchondral bone has been removed and the articular cartilage has dropped into the cavity, causing the familiar erosions, the animal can never again go

sound unless the articulation or bursa has become obliterated through anchylosis or the sensation has been surgically destroyed. But this lesion is not essential to the production of lameness. In some cases we have all the cardinal symptoms of navicular disease or spavin without externally visible changes in structure, such as exostosis, synovitis, or periostitis, and their prompt recovery forces us to conclude either that an error in diagnosis has been made or that the pathologic condition was such as to admit of prompt resolution. We do not believe that a prompt recovery from what appears as typical navicular lameness is conclusive evidence of diagnostic error, but hold it not only to be possible, but of not very infrequent occurrence. So with other forms of the disease, and we must find other explanation for the pain. We have observed well-marked cases of general soreness with typical symptoms of navicular disease or other member of the group which responded quickly to treatment, and in which neither erosions, exostoses, periostitis, nor synovitis could be recognized or their presence in a serious degree suspected, and we were forced to the conclusion that the intra-osseous pain resulting from the pathologic changes going on is responsible for the lameness. In one case of very severe lameness, a careful autopsy failed to reveal superficial lesions in keeping with the pain, and it could only be attributed to intra-osseous pain resulting from the ostitis. In Figs. II and III at B the inflammation would seem sufficient to induce lameness without the lesions at C.

In many cases, especially in ringbone, there is severe lameness without good proof of erosions, and the exostoses are so situated as to not interfere materially with the movements of the articulation. It is impossible to determine here whether the pain is caused by the exostoses or by the intra-osseous changes; probably it should be referred to both, but after the subsidence of the active inflammation, we observe repeatedly that exostosis does not cause pain. Whether within the original bone, within the new formed bone, or in the periosteum, the lameness must be due to inflammatory processes still at work.

The synovitis in itself probably causes lameness sometimes, though we do not find cases, except perhaps in navicular disease, where manipulation can induce pain. With the common tendency toward anchylosis, we must anticipate frequent interruptions in the process; two bones will become partially anchy-

losed, and the destruction of motion be sufficiently effective to cause a cessation of pain, but an accident or hard work may interrupt the anchylosing process and suddenly cause more or less severe lameness.

In other cases, not very rare, the lameness, when appearing suddenly, can only be attributed to fracture, the bones having become so weakened that they break from ordinary use, as is seen in split phalanges and as might readily occur in the navicular bone in a case like Fig. XIX. In yet other cases, the lameness is due to the tearing away of the tendons from the softened bone. Finally there is a tendency in some of the larger joints, as at N^1, Fig. VIII, to the calcification of the synovial fringes and their ultimate detachment and escape into the synovial cavity, where, floating freely, they may become engaged between the ends of the bones, causing sudden and extreme lameness until such time as the floating body may become dislodged.

SYMPTOMS.

The symptoms of this group of lamenesses are exceedingly varied and complicated. The advent of the affection is usually slow and insidious, but it may appear suddenly and pursue a rapid and violent course. In many cases ringbone and spavins appear in young animals so insidiously that even with two spavins and four well developed ringbones, there may be no lameness or stiffness to attract the attention of the owner, the animal may be thrifty, in good flesh and growing well, the exostoses attain their growth and become wholly quiescent and remain so, the animal performing ordinary work during its lifetime without apparent difficulty of any kind, the exostoses having the simple value of blemishes. As a rule, it may be said that the younger the animal the less serious the exostoses and other lesions of which this may be the chief expression. In these cases where the owner observes no symptoms of lameness or difficulty of locomotion, it is not unlikely that the trained eye would note a peculiar stiffness of gait, a disinclination to run and play, a caution in locomotion, a "tied in" gait. Certain it is that in numerous cases of a very insidious type, in young and old animals alike, there is no distinct lameness, but for weeks or months, exceptionally for years, there is an ill defined soreness in the gait, not amounting to lameness, but abbreviating

FIG. XIX. — Two navicular bones, seriously excavated by disease, illustrating how fracture of that bone may occur. Upper row, Inferior surface of navicular bones. Lower row, The same bones cut transversely and showing extensive excavation in the interior, largely destroying the strength of the bone.

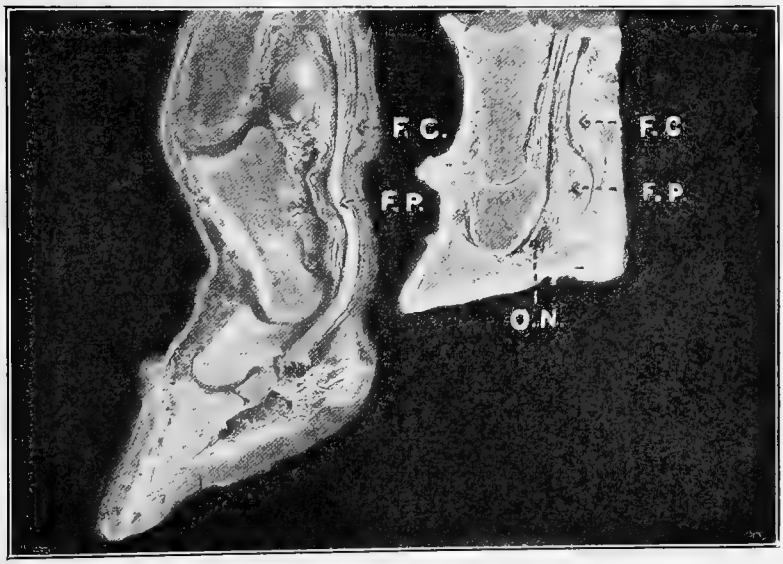

FIG. XX. — "Breaking down" after neurotomy for navicular disease.
F. C., Flexor conona tendon.
F. P., Flexor pedis tendon.
O. N., Navicular bone.
In the left-hand specimen the flexor pedis tendon has torn away from the pedal bone, the torn end resting at postero-superior portion of os corona, while other posterior ligaments have given way, permitting great displacement of phalanges.
In the right-hand figure the navicular bone has been displaced along with the flexor pedis tendon. In neither case is the tendon ruptured, but torn away from the bone.

FIG. XXI. — A fore foot showing extensive dissemination of the disease in mild form, there being evidences of carpitis, sesamoiditis, ringbone, sidebones, and navicular disease.

the stride. Generally the undefined stiffness develops more or less rapidly into distinct lameness of varying severity, which is frequently masked in a measure by its symmetrical character, the two limbs becoming simultaneously affected in the corresponding joint. The lameness generally tends to decrease during moderate exercise, and in spavin especially may wholly disappear. Severe work, either at a rapid pace or heavy draft, increases the lameness, and this becomes still further accentuated if after a period of hard labor the animal is kept closely confined for some hours.

In severe cases the lameness increases more or less rapidly in intensity, the number of joints involved tend to increase, the spinal column becomes rigid, and the animal has difficulty in getting up when down, or, after experiencing difficulty, avoids lying down and sleeps in the standing posture.

At times the lameness is very sudden. Perhaps a ringbone or spavin has long existed without lameness, when suddenly, with or without known accident, the animal becomes severely lame, perhaps as the result of a fracture between two imperfectly anchylosed bones, or, as in a case observed by us (W.), what appeared to be a fracture of the navicular bone, like in Fig. XIX, occurred during a journey, the animal starting apparently sound, returning later severely lame in one foot from navicular disease, lameness quickly following in the other foot and continuing in both until neurotomy became necessary. In other cases one of the phalanges becomes cracked without adequate reasons aside from the diseased condition, as shown at 3 in Fig. I. As a general rule, there is no history of traumatism, and in many cases where mechanical injury is alleged the evidence is by no means convincing.

The local manifestation of disease may precede, accompany, or follow the advent of lameness. These consist of the cardinal symptoms of inflammation, any one of which may be wanting. In extensive joints with large synovial sacs, there is usually an increase of synovial fluid. This is notable in gonitis, and constitutes the chief visible change in the joint. In sesamoiditis it is well marked, and in navicular disease the bursa is sometimes so distended as to show in the heel. In spavin, the tibio-astragaloid bursa is frequently distended, serving as a mask for the more definite exostoses of the lesser bones. While authors describe this group as dry arthritis, it seems to us that

the designation is wholly inappropriate, and that as a rule there is increased synovial accumulation.

Exostosis constitutes perhaps the most constant change. It occurs early in the disease and may be of every conceivable degree, from minute elevations of bone, undistinguishable during life, to enormous enlargements sometimes developing chiefly on one side of the joint, tending to throw the bones out of their normal direction, causing great deformity. The exostoses are nearly always symmetrical, which may lead to confusion, two spavins of equal size being frequently regarded as "rough" hocks.

Heat is rarely recognized as a symptom, but may be present in very active disease of such a joint as the hock or stifle.

Pain is chiefly expressed as a result of locomotion or the bearing of the animal's weight upon the affected part. It cannot generally be induced by ordinary digital compression or manipulation. In navicular disease, pain is evinced sometimes by striking the sole or frog with a hammer, by pressing over the bursa with hoof testers, and by compressing the bursa from the heel with the thumb. Compression of the navicular bone by causing the animal to bear its weight on a wedge, with its base directed forward also causes an expression of pain.

In spavin, the flexing of the hock (spavin test) by compressing the small bones of the tarsus causes pain which finds expression in increased limping when the foot is released.

The constitutional symptoms are of every grade. In a large proportion of cases they are absent or too inconspicuous to attract attention. In severe cases there are general symptoms of ill health, in numerous cases the patient is listless, very disinclined to move, there are digestive derangements, with marked loss of flesh.

As already related under pathology, the urine appears to contain an excess of phosphates. This symptom has not yet been sufficiently studied to make it reliable and available, but we have strong hopes that in the near future urinalysis may become a valuable guide in diagnosing the malady.

DIFFERENTIAL DIAGNOSIS.

We need to differentiate this group of affections from other maladies and also to distinguish between the individual members of the group.

As a group one of the important characteristics is the absence of traumatism. Admittedly traumatism at times occurs and modifies the localization and intensity of the visible disease process, but these cases are so exceptional and stand out so boldly as to rather emphasize the rule.

Another important factor in differentiation is the well-nigh constant multiplicity of lesions. They are largely symmetrical, if one hock has a spavin, so has the other; if there is one ringbone there are probably others, if navicular disease exists in one fore foot it is well-nigh sure to co-exist in the other. If a spavin is present, a search will probably reveal slight ringbones, if gonitis appear, there can probably be found a spavin or ringbone. Most practitioners do not search for these and many fail to recognize their diagnostic value, which is their sole importance as a rule, because the smaller of these exostoses are not unsightly and have little danger for the usefulness of the patient.

The character of the lameness is quite unlike traumatism whether infected or aseptic. In the former of these two there is a tendency to suppuration or erysipelatous inflammation, in the latter, like strains, etc., there is sudden lameness quickly reaching a crisis and gradually receding. In this group the lameness is insidious and persistent, with the few exceptions we have noted.

The local manifestations possess a high value, the exostoses are characteristic and we rarely meet with bony enlargements likely to be mistaken for these. It is true that the exostoses may be of so small size that different examiners will hold different opinions and admittedly they exist in imperceptible gradations and finally reach a point where their presence or absence cannot be decided during the life of the patient.

We have already referred to the subject of urinalysis under the heads of pathology and symptoms.

The differentiation between the lamenesses arising from the various members of the group is frequently difficult and not rarely impossible. It is not always essential that the differentiation should be clear, yet is nearly always advantageous.

If a horse, lame in a hind leg, presents an evident spavin and at the same time shows gonitis with the rigid stifle and distension of the femoro-patellar capsule, we may rest assured in the present state of our knowledge, that he is lame in the stifle, but may not be able to exclude the hock. We might find

a modification of the lameness by inducing local anæsthesia of the hock and thus exclude the spavin.

Spavin and ringbone exostoses frequently occur together and are difficult to differentiate. The spavin test is uncertain as the flexion usually involves violence to both parts, though the compression on the ringbone may be reduced to a minimum by exerting the force upon the metatarsus instead of the toe.

If one of the exostoses is old and the other recent, the lameness may be fairly attributed to the latter.

The best method of differentiation is local anæsthetization of the plantar nerves.

In the fore foot we find difficulty in differentiating between ringbone, sidebone, and navicular disease, and in some cases we meet with compound lameness, all three being present, as is shown in Figs. XVIII and XXI. The presence of ringbone prohibits, especially if it is low, the detection of navicular lameness, as any test which we may be able to apply to the one will act very similarly on the other. The sidebones frequently extend up so high as to cover over or become continuous with ringbones in which case we are powerless during the life of the animal to differentiate. The common presence of sidebones and ringbones in draft horses with navicular disease prevents the diagnosis of the latter and leads to the opinion that it does not occur in draft animals. When but one form of exostosis is present and we can detect no navicular disease, we may assume its absence, but it is not safe to base a prognosis upon such assumption.

In the absence of exostosis, navicular disease is fairly easily diagnosed. It must always be remembered in differential diagnosis that a horse limping to-day from a slight ringbone may be lame to-morrow from navicular disease, conditions which give abundant room for professional friction when different veterinarians examining a horse at close intervals clash in diagnosis. Each may be correct.

COURSE AND TERMINATION.

As in other diseases resolution may, and frequently does occur. When recognized early in its course ere irrecoverable lesions have occurred, the causes removed and prompt measures taken to correct the local and general disturbances, recovery may be complete and permanent.

In other cases the constitutional changes are so rapid and severe that the animal quickly loses condition, is listless, disinclined to move, becomes greatly emaciated, spontaneous fractures occur or the case otherwise becomes hopeless and the animal is destroyed.

The vast majority of cases pursue courses between these extremes. Many young animals develop multiple exostoses without notable lameness, anchyloses occur in some of the smaller joints, the patient recovers its general vigor and goes through life doing satisfactory labor without lameness.

Many other cases, especially in young animals, are lame for a time, but if the joint be of limited motion, anchylosis may occur after some months or even years and the lameness disappear. Subsequent to anchylosis the lameness may recur in the affected joint at any time during the patient's life, due either to a return of the disease process or to an accidental disturbance of an imperfect anchylosis. Sixty to seventy-five per cent. of spavin and ringbone lameness in young animals end in recovery by anchylosis if early attention be given.

In the residue of these cases and in sixty to seventy-five per cent. of aged horses that become affected, the disease in these joints resists treatment and remains permanent, seriously diminishing and frequently destroying the value of the animal. The character of the articulation modifies greatly the prognosis. When the disease affects the stifle (gonitis), a colt may recover, but the collection of synovia in the femoro-patellar capsule usually floats the patella outward, causing it to pass over the external femoral condyle producing "floating" luxation, ending in a failure of the external condyle to develop, thus destroying the trochlea and even if the disease processes abate, the patella slips out and in at each step and the animal is worthless. This result is well shown in Figs. VIII and IX. Anchylosis being barred in such articulations, when important changes have occurred in the joint, the lameness becomes permanent and disabling.

In some cases of chronic navicular disease, it is believed that the flexor tendon and bone become anchylosed and alleviate or stop the lameness. In one very lame dissecting subject, we found firm anchylosis between the bone and tendon.

Anchylosis cannot well occur in important joints, and when it does, that in itself renders the animal useless. Anchyloses of the vertebræ, especially in the lumbar region, are not rare; when

limited they may not interfere greatly with the animal's movements, but when extensive, render its movements stiff and interfere with lying down and getting up.

Fractures may occur either in what we may term a spontaneous manner, that is, in the course of ordinary movement, or function, or accidentally from some extra insult.

We have already referred to the thirteen broken ribs shown in Fig. XVII, in which the fractures were scattered irregularly over both sides of the chest and had apparently occurred singly and without any violence. The spine is liable to become so fragile as to fracture spontaneously in getting up, and the pasterns and navicular bones occasionally give way in a similar manner without adequate violence; the admirably protected pedal bone may give way on its plantar surface, permitting the tendon of the flexor pedis to pull out, carrying a portion of the bone with it. While this may occur in any case, it is especially prone to follow neurotomy with the consequent weight put upon the pedal bone which in its pathologic state it is unable to bear.

The "accidental" fractures occur variously, by falls or blows like other fractures, only more certainly induced under slight provocation.

Of greatest interest to us are the fractures from casting for operation. A large proportion of animals suffering from fractures during casting accompany confinement for some surgical operation for spavin, ringbone, navicular disease, or some other member of the group. The fact is significant and we habitually decline to cast a colt for castration except definitely at the owner's risk when the presence of exostoses referable to this group are evident. We regard the casting of these animals as a constant danger quite out of proportion to ordinary casting risks and when necessary to confine such a patient for any reason, are careful to stipulate that it is done specifically at the owner's risk after he has been fully advised of the dangers.

PROGNOSIS.

The prognosis of the disease has been largely covered incidentally in the preceding section.

The probability of life is excellent, the fatalities occurring almost only in severe cases of the maladies or forms known as osteo-porosis and rickets.

The prospect of resolution without visible traces of the malady are remote, only those few cases which we are able to diagnose prior to the establishment of extensive lesions or which without recognition undergo some change in environment or care offering hope for complete recovery.

A large proportion recover their usefulness through a restoration of any lost vigor, repair of the affected bone and other tissues, or the anchylosis of joints of limited motion. In other cases, changes in shoeing and other forms of handling alleviate the pain and render the animal capable of doing certain kinds of labor in comparative comfort, especially slow work on soft ground.

A goodly part of the total, perhaps twenty-five to thirty per cent., remain permanently lame and essentially worthless.

TREATMENT.

The handling of this group of affections may be undertaken with a variety of objects in view, according to conditions. We may aim at the attainment of resolution, the repair of the affected parts with permanent blemish, the production of anchylosis, the alleviation of pain, or the production of anæsthesia.

Any attempt to induce resolution necessarily demands our attention to the care of the animal, especially in relation to the character of food, housing, and exercise. In discussing the causes, we have necessarily indicated indirectly that in order to abort the affection in its early stages, we would do well to allow a variety of food of good quality, and preferably the freedom of the pasture. If the exigencies of weather or surroundings demand housing, we would desire the ordinary hygienic conditions, including regular daily exercise of a moderate kind. These conditions are also advisable as contributory to other methods of treatment at any stage of the affection.

Internal medication has not been placed on a secure experimental basis. While some writers, in cases of rickets or other disease involving increased excretion of phosphates in the urine, advise the internal administration of these, claiming good results, although advising with it other medication and care which would probably favorably affect the course of the disease, others have found no benefit from the administration of phosphorus.

Although we can readily comprehend the reason for administering phosphates as an alterative and thereby hope to secure

good results, we fail wholly to see why, when the system is wasting phosphates, we should supply more to be added to those already being excreted. There are enough phosphates in the food and perhaps in the body, but the organism is repelling the element and discarding it from the system. We consequently incline rather to attempt in some way to cause the system to assimilate and conserve the phosphorus on hand. Without knowing the exact nature of the disease, it is difficult to formulate a system of medication.

Were we to assume that the disease is an infection or intoxication, we would turn to those substances which, when given internally, may be believed to exert a bactericidal power or cause the elimination or destruction of their products.

In the cases termed millet disease by Hinebauch, he secured apparently good results by the administration of salicylate of soda and nitrate of potash. Berns has reported good results in the treatment of osteo-porosis with the salicylate. Possibly bitter tonics would act similarly.

We have had some apparently excellent and specific results from the administration of potassium iodide in daily doses of one-half to one ounce or more, especially in acute cases of recent origin, accompanied by general soreness of the skeleton where the patient was, so to speak, "lame in all four legs and stiff in the back." The recovery in several cases, where double navicular disease seemed clearly present, along with general symptoms mentioned, has been prompt and enduring. We have usually combined the iodide with nux vomica.

We may further favor resolution by relieving the most vulnerable parts in which the disease threatens to localize by diminishing the labor or stress demanded of the part. The same processes tend to alleviate the disease when once established, and increase the usefulness of the horse. A good example is the high-heeled, or the roller motion shoe which relieves the tension on the flexor pedis tendon and thereby alleviates navicular disease and sometimes ringbone or spavin. The same is true of the elastic padded shoes which relieve the concussion. Partly in the same manner relief is sometimes had from pain due to those members of the group having their location within the hoof, by relieving the encased parts from the pressure of hard, dry hoofs by mechanical expanders or expanding them by maceration.

Of distinct use, both as a curative agency in the earlier stages and as an alleviating remedy in confirmed lameness, is the application of cold water. The continuous irrigation probably serves the best purpose and there are numerous methods for applying this, but we question if any equals in efficacy the standing of the horse in a cold, running stream where such a method is available. The highest efficiency of this treatment is attained by continuing it for four or five hours daily over a long period of time.

The application of warm or hot water or packs is counselled by some and possibly has a value approximating that of cold.

In attempting to alleviate pain and restore usefulness through the medium of anchylosis, various means are used, having generally a tendency to excite a more acute and reparative inflammation. Mildest among these are stimulating liniments and vesicants, and for these purposes anything and everything which will irritate has been used and recommended. In former days the aromatic oils like origanum, spike, and others were in high repute and perhaps justly so. They are still used, as is also to a large extent camphor and turpentine. Iodine and mercury have a prominent part in veterinarian's prescriptions and patent nostrums and possess reasonable efficiency. None of them are reliable and are generally considered inferior to more radical measures.

Subcutaneous injections over the affected part of oil of mustard, turpentine, concentrated salt solution, and other substances have been advised and cures reported.

Setons were formerly in vogue with many, especially in spavin and navicular disease, and apparently exercised a beneficent tendency, but they have been largely discarded.

Cautery has long been in high favor and is perhaps the most universally applied of any form of treatment in these affections. It is applied in the two forms of line and puncture firing with endless deviation in extent, intensity, and plan. The method is largely a question of choice, though we believe the present tendency is rather towards multiple deep punctures. The instrument for the firing is purely a matter of choice, most veterinarians now using the thermo-cautery as being more convenient and neater. An old form of treatment for ringbone and spavin was the now obsolete spavin punch, in which a group of sharp steel spikes were driven into the exostosis of spavin or ringbone. We know little of its efficacy.

Dieckerhoff introduced and recommended the tenotomy and tendo-vaginotomy for the relief of spavin, an operation not applicable to other members of the group, but having distinct merit in the one disease.

Periosteotomy has been repeatedly used and commended in such exostoses as ringbone and spavin and has proven effective in many cases. Peters introduced a combination of tenotomy and periosteotomy for the cure of spavin which bears his name.

We and others have resorted to fixation in some cases, especially in spavin, with good results. The effect has been highly favorable in very severe spavins with intense inflammation and swelling and such excessive lameness that the animal declined to bear any weight upon the affected limb. In such patients the encasement of the affected member in a firm plaster of Paris cast gave prompt and grateful relief with rapid abatement of the swelling and inflammation and early recovery of ability to work. Fixation has not been sufficiently tried in the more common type of cases.

When the foregoing means have failed to cure or ameliorate the disease, there remains as a final resort, the destruction of the power of feeling either temporarily or permanently. Temporarily, by local anæsthesia, the chief legitimate motive is the use of cocaine or other like drug for diagnostic purposes. A recent writer has stated that in one case the injection of cocaine and adrenaline gave permanent cessation of lameness. The proposition needs further proof.

Generally we aim to produce permanent anæsthesia of the part by neurotomy. Much discussion has been had as to where we should operate for a given case of disease. Generally speaking, the best place to operate is the nearest point on the proximal side of the affected part where the sensory nerve supplying that region can be readily reached. The larger the nerve trunk, the more permanent the interruption of sensation. In case of the digital nerve, — low neurotomy, — the innervation of the part is frequently restored after six to twelve months. Neurotomy is properly only a final resort and is not otherwise justifiable because of the dangers involved. The chief and ever-present danger from the operation is the placing upon the weakened bones of the foot of an increased amount of weight which, in their diseased condition, they cannot bear; this apparently intensifies the rarefying ostitis within the bones and corresponding degenerative

processes in the tendons and other parts. The bones become more porous and their power of resistance decreases until they crush under pressure, or yield to tension of their tendons or ligaments, the ends of the latter tearing away accompanied by fragments of the degenerate bone. Or the tendon may so far degenerate as to part transversely.

It is not always the part which was considered chiefly diseased before operating that gives way after neurotomy, but may be some other bone or tissue. For example, after neurotomy for navicular disease, the navicular bone is fairly protected, and may escape serious injury while the disease processes in the pedal bone, previously ignored, become intensified and the flexor tendon tears away from its semilunar crest carrying portions of bone with it. Following double neurotomy for spavin the breaking down may occur in the tarsal bones, the sesamoids, the os pedis, or the flexor tendons.

Neurotomy has the further danger that in the absence of sensation, any injury to the part is unheeded, and the highly protective office of pain is wanting so that the patient continues to use the injured part with disastrous results, preventing the healing of the injury, causing it to extend and finally destroying the foot. (Fig. XX.)

The selection of cases for neurotomy requires a high degree of judgment. After excluding all badly formed feet and all which are suffering from or tending to infections, we still need to determine which will bear the new strain put upon them when the pain is removed.

The general rule is that we should not unnerve an animal which is acutely or extremely lame, in bad general condition, or in a recent case. This rule is in full harmony with our view of the constitutional character of the disease and would warrant our stating the above rule in a new garb — do not perform neurotomy so long as the general disease is active, but wait until the systemic disturbance has passed and the question has resolved itself into a painful, incurable local lesion, the parts retaining sufficient vitality to safely resume their normal function when the sense of pain is destroyed.

Opinions of neurotomy will always vary because in different localities and among different classes of horses the seriousness of the systemic disease will differ. In those areas where the disease is generally mild and the active systemic disturbance

promptly passes, leaving only a local permanent one, the operation proves comparatively safe, while in those regions where the disease is usually severe, with long continued and serious systemic disturbance, it becomes highly dangerous. Veterinarians operating on the two different classes will have opposite views as to its safety. We have seen cases of plantar neurotomy for navicular disease go down in thirty days, and under different conditions another work perfectly for ten or more years.

The ethics of neurotomy is an embarrassing question for the practitioner. No more humane or economic operation is known to the veterinarian in properly selected cases, relieving constant suffering of a severe type and restoring to usefulness an animal otherwise no longer fit for work.

But probably eighty per cent. of unnerved horses are illegitimately or surreptitiously sold to an innocent purchaser, and the important question arising is the moral responsibility of the operator. Plainly the veterinarian has for a money consideration disguised a serious unsoundness in an animal and has thereby aided the vendor in imposing upon an innocent purchaser. Where an owner submits an animal for the operation with a clear intent to use the horse legitimately whether at work or in sale, the freedom of the veterinarian is evident, but when he clearly desires the operator to aid him in making a dishonest sale, it seems to us that he becomes a party to the fraud. Between these two extremes the question of propriety on the part of the veterinarian vacillates.

A recent German writer proposes that in performing neurotomy care should be taken to leave an unsightly and telltale scar to warn the unwary purchaser, but this device would only warn the wary buyer, and no scar, soever large, would protect the uninformed. Neither would most of us agree to perform an operation in such a bungling and unsurgical manner as to insure a scar where it can be generally avoided.

Strict laws with severe penalties or selling unnerved horses without the knowledge of the purchaser might be made to check the evil.

EXAMINATIONS FOR SOUNDNESS AND SALE.

In the examination of horses offered for sale, the search for the spavin group of lameness constitutes an important part, largely because they may be disguised. Their bilateral

symmetry frequently gives the animal a short gait, which it is difficult to identify as lameness. The lameness in some members of the group disappears with exercise as is specially observed in spavin. The symmetrical exostoses on both legs confuses the inexperienced and at times leads the experienced astray. The application of local anæsthesia effectively masks the disease temporarily, or the animal may have been unnerved.

It becomes necessary, therefore, to eliminate every possibility of fraud by delaying examination until the effects of exercise or cocaine shall have vanished and careful search made for neurotomy. In addition to these precautions, a rigid search for the lesions of the disease is assumed. When evidences of the malady are discovered, the examiner needs place some value upon it.

Some say that a horse with spavin, ringbone, etc., is unsound and that condemnation is mandatory. A buyer does not care, if intelligent, if a horse is sound or unsound. We would not attempt to say that a horse was sound or unsound, but would give him a conscientious examination, record our findings, and interpret them as well as our judgment would permit.

An animal with quiescent lesions, like ringbone or spavin, which are not interfering with locomotion and in which all systemic disturbances have passed by, will probably work or breed indefinitely without disadvantage. Admittedly lameness may and does recur in these animals, but we have no data to show that a larger per cent. become lame than of horses not previously affected. The blemish resulting from the exostosis has a varying value according to size and the class of horse. In common work animals the blemish is of little consequence, but in horses of special value the blemish may be exceedingly serious.

Our views of the breeding value of animals affected with a member of this group have already been suggested when discussing heredity as a cause. If not a hereditary affection, and we believe it is not, then it cannot be objectionable from a breeder's standpoint. If an animal has a badly formed hock, he is clearly rejectable on that ground whether spavined or not, but if a foal is kept under improper environment, and thereby acquires a spavin on an otherwise excellent tarsus, we see no more reason for excluding him from the breeding stud than though he had a callous from a broken leg.

When active lesions are present the horse is unfitted for either work or breeding according to intensity.

OTHER MALADIES POSSIBLY ALLIED TO THIS GROUP OF AFFECTIONS.

In this great group of diseases it is not easy to definitely limit it in its scope. If, as alleged in this discourse, the disease is systemic in character, any tissue may suffer. In the one case related and shown in Figs. XVII and XVIII, we stated that the various affections belonging to this group were revealed as a consequence of the presence of tendonitis and tendo-vaginitis. These affections seemed to be the initial appearances of interruption of the convalescence from contagious pneumonia.

This tendonitis and tendo-vaginitis is a common complication of contagious pneumonia, and closely associated with the appearance of the spavin group of lesions. Clinically they are closely related and seem to be due to the same causes. It is a common assertion, moreover, that in this group of lamenesses, the flexor tendons occasionally part, though in reality they generally merely pull away from the bone, carrying parts of osseous tissue along.

Another interesting malady which appears in the region of Ithaca, New York, quite abundantly consists in the gradual sinking of the os pedis without history of laminitis or other disease. It seems identical with what Moeller describes as sinking of the os pedis, and which is rendered by Dollar in his translation as standing laminitis.

In cases which we have met, navicular disease is present, and it seems possible that in flat-footed horses, in attempting to throw the weight on the toe of the hoof, the os pedis slips backwards and then downwards, carrying the sole with it. Moeller attributes it to standing on one foot while the corresponding member is disabled. As we have seen it here, both pedal bones sink simultaneously and insidiously without discernible cause, under the same conditions most common in the spavin group.

These addenda are only suggestions as to a possible relationship which may yet prove of interest.