

## ARTHRITIS IN CATTLE\*

J. L. Shupe†

ARTHRITIS, while not limited to cattle, has been recognized in this species since the beginning of veterinary history (4). Despite this long-standing recognition and the fact that arthritis presents definite clinical symptoms and lesions of diagnostic, prognostic, and pathological importance, surprisingly few studies delving into the cause and pathology of this important disease process in cattle have been reported. From an economic viewpoint, the livestock industry takes a considerable yearly loss from the effects of arthritis (11). A large number of animals are condemned at slaughter houses each year, the medical attention required for afflicted animals is expensive and afflicted animals have poor performance records.

Comparative evaluation of this disease as it occurs in man and animal has already proved valuable, and further investigations along such lines should be worthwhile.

Joint lesions which cause arthritis may be divided into two general categories: inflammatory and degenerative (1). The inflammatory type is often proliferative, especially in the later stages. In the earlier stages, exudative signs play the predominant role. The degenerative type of lesion has been designated by a variety of terms such as arthritis deformans, osteoarthritis, chronic articular rheumatism, chronic osteoarthritis, chronic osteoarthrosis, hypertrophic arthritis, degenerative joint disease, and chondromalacia arthrosis. We prefer the term arthrosis or, more fully, arthrosis deformans. The term arthrosis distinguishes the degenerative from the inflammatory type of joint diseases, the etiology and pathogenesis of which are different. Terms ending in "osis" generally describe degenerative processes such as nephrosis, while the ending "itis" should be reserved for truly inflammatory processes such as nephritis. This conforms with the original meaning of the Greek genus "*itis*".

In any study of lesions involving the joints, it is imperative to appreciate the four characteristics of articular cartilage: (1) avascularity, (2) insensitivity, (3) low metabolic rate, and (4) poor reparative ability. The concept of the musculoskeletal system as a structural and functional unit must also be kept in mind when studying and evaluating arthritis. This unity is reflected whenever one of the three major components (bones, joints, and muscles) of the locomotor system becomes abnormal and the other two ultimately undergo secondary changes (10).

### MATERIAL AND METHODS

During the past eight years, bones and joints from 379 animals of various dairy and beef breeds have been studied. These animals ranged in age from one day to 21 years, with the majority between 5 and 10 years of age. In the selection

\*The research for this paper was conducted at Utah State University.

†Animal Disease and Parasite Research Division ARS, USDA, Logan, Utah. Formerly of the Veterinary Science Department, Utah State University, Logan, Utah.

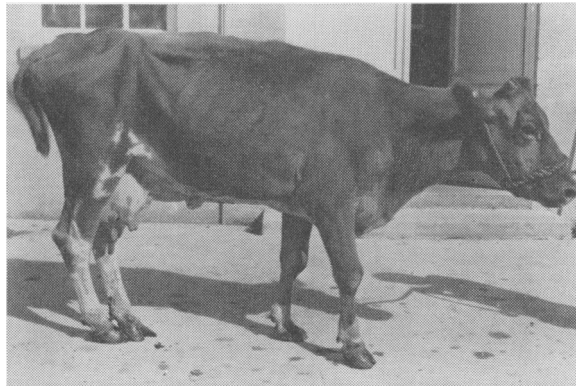
of each case, careful consideration was given to the animal's existing clinical symptoms and its past history of systemic disorders or infectious diseases. Practically all animals were clinically observed and examined before necropsies were done. The joints and tissues from all animals were subjected to gross and microscopic studies and evaluations. All sections taken were X-rayed before being prepared for macroscopic and microscopic examinations. Longitudinal and transverse sections of articular and sub-chondral bone were taken for evaluation and study. The specimens were fixed in 10% neutral formalin. Routine decalcifying, embedding, and staining procedures were used to prepare sections for microscopic evaluation. Hand-ground macerated sections of bone were prepared and examined grossly and histologically.

#### ANAMNESIS AND SYMPTOMS

The inflammatory group of arthritic disorders can be attributed to a number of known causes. Specific infective agents such as *Brucella abortus*, *Erysipelas spp.*, *Staphylococcus spp.*, *Streptococcus spp.*, PPLO, and *Pneumococcus spp.* have been isolated from infected joints. These infectious agents can localize in joints and elicit typical inflammatory reactions (3). In severe cases they may even be part of a more generalized septicemia. Such acute or subacute processes localize mainly in the periarticular tissue and hence primarily involve the capsule of the joint. Later stages may develop into more degenerative conditions which go under the name of osteoarthritis.

The clinical diagnosis presents few difficulties to anyone familiar with the syndromes of diseases of the joints (2). A complete history of the case when combined with clinical findings helps in making a differential diagnosis. In addition, when distinguishing between inflammatory and degenerative arthritis, one should realize that a spastic paresis of the hind limbs can be confused with the more mechanical impairments of the joint which are seen in arthritis.

Slow progressive lamenesses involving the larger, freely movable, weight-bearing joints of cattle over five years of age appear to be the most constant signs associated with degenerative arthrosis. The condition is rarely limited to one joint or limb (6). A prominent sign is pain on moving and standing which is relieved when the animal is recumbent (fig. 1). Signs such as elevated body



*Figure 1.* Eight-year-old Guernsey cow depicting abnormal stance resulting from an advanced case of degenerative arthritis.

temperature, hot swollen joints, anorexia, and suppressed ruminations, which are typical of inflammatory arthritis, are not present in degenerative arthritis. In many advanced cases of arthrosis, crepitus can be readily discerned when the animal moves. Secondary muscular atrophy and malfunctioning joints become evident as the disease becomes more severe. The clinical manifestations and the course of the disease vary with the biological response of the individual animal.

Familiarity with the anatomy and aging processes of normal individuals of the species is imperative in order to detect pathological changes (7). Inheritance sometimes appears to be a factor which predisposes to degeneration. This theory can be supported by pedigrees and records of certain, well documented cases. Cattle with straight hind legs seem to be more susceptible to arthritis because of the constant strain and injuries to the joints that result from improper support of the body weight (8). On the other hand, many straight-legged cattle do not develop this condition and, conversely, some of the seriously affected animals are not straight-legged.

In older bulls degenerative joint changes often result in the inability to breed (9). Impaired locomotion and activity due to affected joints has resulted in the slaughter of many valuable bulls. Spastic contractions of the hind limbs have been seen in young bulls and cows, but are most frequently observed in older bulls. There is also a hereditary condition causing spastic paresis of the hind limbs in calves. In most cases, however, these animals are removed from the herd before they reach one year of age (5). A number of yearling bulls go through a period of swollen hocks, but they tend to overcome this condition as they mature. The age and management of the animal are associated with the clinical manifestations of the disease. Large, heavy bulls, housed in small stalls with concrete floors, have a high incidence of puffy hocks and experience great difficulty in standing up. Animals raised in open box stalls with outdoor non-concrete runs that provide ample room for proper exercise are not as likely to develop the spastic arthritis-like syndrome and degenerative changes as early in life as animals housed in small, inadequate stalls with concrete floors.

#### PATHOLOGICAL FINDINGS

Inflammatory arthritis may be serous, fibrinous, or purulent. Advanced cases show proliferation of both the synovial membrane and the outer layer of articular cartilage, combined in many cases with a proliferation of pericapsular connective tissue. Thickening of the articular capsule and an increase in the amount of joint fluid cause joint enlargement. The degree of erosion of the articular cartilage varies with the age, the stage of inflammation, and mechanical factors.

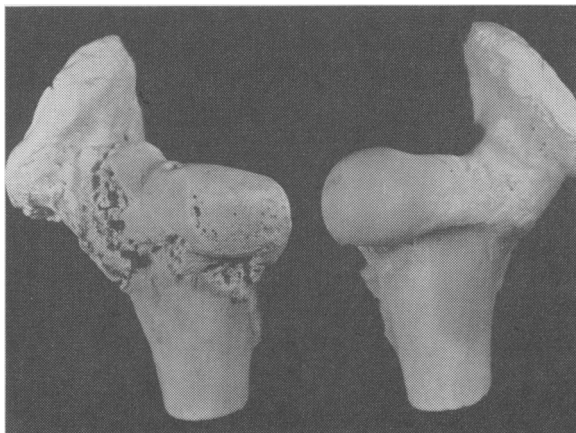
The extent of the lesions associated with degenerative arthrosis is influenced by many factors. We have listed before some of the terms used to describe such degenerative joint diseases. Some of these are merely descriptive terms derived from empirical findings, clinical signs, tissue changes, and X-ray observations. Age certainly plays a role, as this disease occurs chiefly in older individuals. The anatomical structure and basic function of specific joints influence the manifestation and incidence of lesions and symptoms; the larger, freely movable joints are more severely and more frequently involved. Some correlation has been noticed between the weight of the animal and the severity of the pathological changes.

Irritation, trauma, and shearing action also are correlated with the degree and extent of the lesions. Faulty conformation and malalignment of joints seem to predispose the intra-articular tissues to greater stress and wear.

The initial stages of degenerative changes seem to occur in the articular cartilage. The normally wet, smooth and glistening cartilage takes on a dull, dry, opaque, yellowish and granular appearance. Small clefts and fissures then appear, followed by splitting and fibrillation of the articular cartilage (so-called asbestos fibers). Progressive erosion of the cartilage continues until the underlying bone is exposed. The exposed bone slowly becomes smooth, polished, and, at times, grooved. These lesions cause further malalignment and malposition of joints resulting in a slow, progressive, vicious cycle in which the injury is constantly aggravated and extended.

The degree of involvement of joint capsules and the amount of joint fluid vary with the severity of the case and the individual animal. In advanced stages and in cases complicated by concurrent inflammatory reactions, fibrosis and thickening of the joint capsules occur simultaneously with an increase in the amount of joint fluid, which contains more protein, masses of fibrin, an increased number of nucleated white cells, and, in cases leading to sequestration, pieces of bone and cartilage, and free joint bodies. Intra-articular ligaments and structures show varying degrees of fragmentation and shredding. Synovial villi become thickened and fibrotic. Fibrosis and hemorrhage of the periarticular tissue are sometimes evident, depending upon the duration and extent of the disease process.

As the disease progresses, overgrowths, which are compensatory changes, appear. Osteophytic growths along articular margins become evident; and new outgrowths of bone of varying sizes, shapes, and density appear along articular borders (fig. 2). The density of the bone adjacent to the eroded areas is con-



*Figure 2.* Proximal ends of femoral bones from two 10-year-old dairy cows. *Left* Degenerative arthritis; *Right* Normal.

siderably increased. Chondrification, followed by ossification of the associated tendons and joint capsule, was marked in several cases that had numerous, various-sized osteophytic structures within the joint capsule (fig. 3).

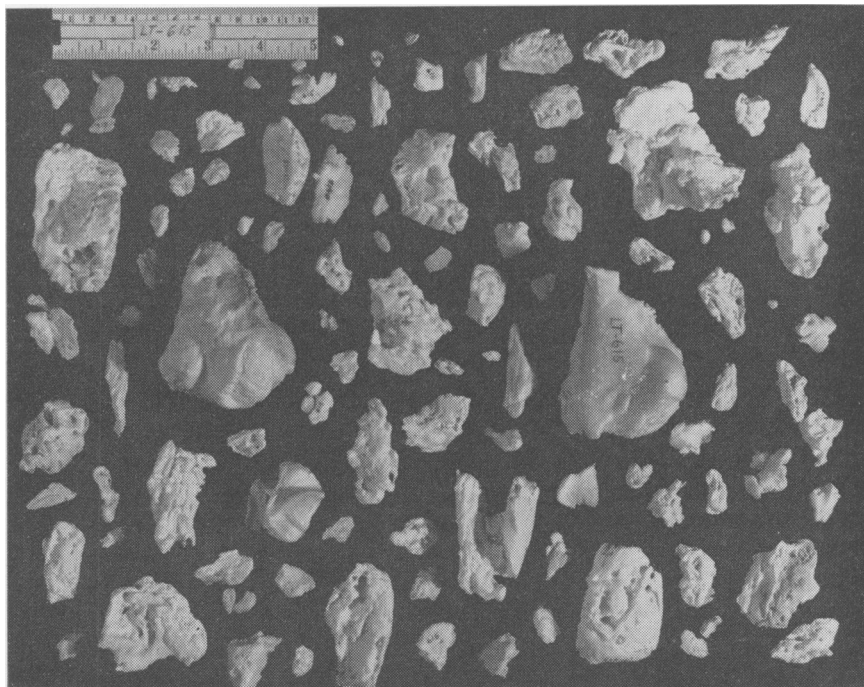


Figure 3. Two patella bones and intra-articular osteophytic structures removed from the stifle joints of an 11-year-old Jersey bull.

Vertebral exostoses and hypertrophic spondylitis are most evident in heavy, older animals. These osteophytic formations usually occur on the lower thoracic and upper lumbar vertebrae. Sometimes, in cases that exhibit hind-limb spasticity, hyperextension and disturbed locomotion, spinal-canal narrowing occurs with resultant pressure on the spinal cord and nerves. Marginal osteophytes on adjacent vertebral bodies cause bridging and malalignment and poor functioning of intervertebral joints.

The degree and extent of lesions can be determined by roentgenographs. Early articular degeneration and erosion cannot be discerned by X-ray. Subchondral cysts have been observed prior to eburnation and marginal lipping. However, some cases did not show evidence of subchondral cysts; and there were instances of subchondral cysts without evidence of osteoarthritis. Marginal osteophytes, coarsening of the trabecular pattern of the subchondral bone, increased density of bone adjacent to areas of eroded articular cartilage and eburnation can be demonstrated.

#### COMMENT

Inflammatory arthritis in cattle is commonly one of three types—serous, fibrinous, or purulent. A number of specific infective agents such as *Brucella abortus*, *Erysipelas spp.*, *Straphylococcus spp.*, *Streptococcus spp.*, PPLO, and *Pneumococcus spp.* have been isolated from infected joints. These infectious agents can localize in joints and elicit an acute or subacute active arthritis. Some of the more acute, septicemic arthritic conditions cause periarticular inflammatory

involvement resulting in secondary capsulitis, which later develops into the progressive, degenerative joint lesions characteristic of osteoarthritis.

Stress and strain on joints, causing constant irritation, appear to be the most important causes of degenerative arthritis or arthrosis. However, not all cases can be attributed to this cause. A relatively high incidence of this disease process in certain family lines of cattle suggests the role of heredity, but no pattern of inheritance has been established as yet.

The development of degenerative arthrosis to the stage of marginal osteophytic formations requires from two to five years and follows a definite pattern. The first discernible gross lesions occur in the articular cartilage. Following degeneration of articular cartilage, subchondral bone changes take place. Subchondral cysts that contain clear, yellowish fluid appear to be associated with early articular cartilage degeneration. Adaptive processes advance as the disease progresses. Marginal osteophytic formations cause malalignment and malocclusion of joints, with a resultant increase in lameness. In advanced cases practically all joints in the fore and hind limbs develop some degree of degenerative and hypertrophic changes; however, the large, freely movable hip and stifle joints show the most striking and severe lesions. This disease can occur in both the fore and the hind limbs and may be uni- or bilateral. Progressive articular and bone changes result in increasing lameness unaccompanied by systemic manifestations in most cases.

To understand joint diseases, one must bear in mind the anatomic and histologic make-up of joints, and the four previously mentioned characteristics of cartilage: (1) avascularity, (2) insensitivity, (3) low metabolic rate, and (4) poor reparative ability. It is important to be familiar with the normal individual variations and physiological processes of aging. The clinical manifestations may vary from case to case and will be influenced by many factors such as the biological response of the individual animal to the disease process.

#### SUMMARY

1. Joint lesions in the bovine species have been recognized since the beginning of veterinary medicine.

2. Joint diseases in cattle are no single disease entity, but encompass a number of different processes, the etiology and pathogenesis of which are known in only some of the cases. Some of the processes are referred to as inflammatory, others as degenerative joint diseases.

3. Some of the changes observed in degenerative joint disease are secondary and result from the disuse of the malfunctioning joint or joints.

4. In general, inflammatory arthritis in cattle is accompanied by systemic manifestations such as elevated body temperature, hot swollen joints, anorexia, depressed appetite, suppressed ruminations, and obvious pain that is not alleviated when the animal is recumbent.

5. Degenerative joint disease is seldom fatal, but often is a chronic debilitating condition. It occurs in older animals and is most often observed in the larger, freely movable joints. It is characterized by degeneration and hypertrophy of cartilage and bone.

6. Pathologically inflammatory arthritis is proliferative in nature in its later

stages at least. Clinically, degenerative arthrosis is characterized by pain on locomotion and standing, and is relieved by rest (recumbency).

7. Comparative evaluation of arthritis in cattle and in man has been most valuable. However, more information is needed about the etiology and pathogenesis of arthritis.

#### RÉSUMÉ

1. Les lésions articulaires de l'espèce bovine ont été signalées depuis l'avènement de la médecine vétérinaire.

2. Les affections articulaires du bétail ne s'apparentent pas à une seule maladie mais comprennent une quantité de réactions différentes, dont l'étiologie et la pathogénie ne nous est connue que dans quelques cas seulement. Quelques-unes de ces réactions sont parfois désignées comme étant inflammatoires, tandis que d'autres sont des maladies articulaires dégénérantes.

3. Certains changements d'ordre secondaire observés au cours des maladies articulaires dégénérantes, sont la conséquence du mauvais fonctionnement des articulations.

4. Dans la plupart des cas, chez le bétail, l'arthrite inflammatoire s'accompagne de signes généralisés, tels que degré de température élevée, articulations enflées et brûlantes, anorexie, perte de l'appétit, suppression de la rumination, douleur manifeste même lorsque l'animal est couché.

5. La maladie articulaire dégénérante, rarement mortelle, amène souvent un état chronique de débilité. Elle se manifeste chez les animaux âgés et on l'observe le plus souvent dans les articulations les plus grosses et qui fonctionnent habituellement le plus aisément. Ses principaux caractères sont la dégénérescence et l'hypertrophie des cartilages et des os.

6. L'arthrite inflammatoire pathologique est prolifère de nature, du moins aux derniers stades de la maladie. D'après la méthode clinique, l'arthrose dégénérative se manifeste par une certaine douleur lorsque l'animal est en mouvement ou demeure debout, mais disparaît complètement lorsqu'il est couché.

7. L'évaluation comparative de l'arthrite chez les animaux et chez l'homme a été d'un grand secours; cependant, nous avons besoin de plus d'observations quant à l'étiologie et à la pathogénie de l'arthrite.

#### ACKNOWLEDGEMENT

The author wishes to acknowledge Dr. Jurgen R. Meyer-Ardent, M.D., for his critical review of the paper and Arland Olson, M.S., for his technical assistance.

#### REFERENCES

1. ALLISON, N. and GHORMLEY, R. K. *Diagnosis in Joint Disease. A Clinical and Pathological Study of Arthritis.* New York: William Wood. 1931.
2. FOWLER, G. R. and KINGREY, B. W. *Diseases of Cattle.* pp. 399-406. Fincher, M. G., Gibbons, W. J., Mayer, K., and Park, S. E. (Eds.). Evanston: American Veterinary Publications Inc. 1956.
3. GOLDBERG, S. A. The structural changes that occur in certain non-specific inflammations of joints. *Ann. Report, New York State Veterinary College, Cornell University, Ithaca, New York* 142: 143-195. 1914-15.
4. GOLDBERG, S. A. The pathology of arthritis. *Am. J. Clin. Path.* Vol. 14, No. 1, pp. 1-23. Jan. 1944.

5. GOTZ, R. Spastic paresis of the hind extremities in calves and young bovines. *Deutsche Tierartzlicht Wochenschrift*. p. 197. 1938.
6. HUTYRA, F. and MAREK, J. *Special Pathology and Therapeutics of the Diseases of Domestic Animals*. Vol. 3, pp. 537-551. Chicago: A. Eger. 1926.
7. JOHNSON, L. C. Kinetics of osteoarthritis. *Lab. Invest.* 8: 1223-1241. 1959.
8. MARCENAC, N. and FLORENTIN, P. Osteo-arthritis d'origine mecanique du cheval. *Rev. Rhum.* 23: 820-833. 1956.
9. McENTEE, K. Pathological conditions in old bulls with impaired fertility. *J. Am. Vet. M. A.* 8: 328-331. 1958.
10. PUTSCHAR, W. G. J. General pathology of the musculo-skeletal system. Department of Pathology, Charleston General Hospital, Charleston W. Va. 363-461. March, 1958.
11. SHUMAN, R. D. Swine erysipelas and arthritis. *Lab. Invest.* 8: 1416-1418. 1959.

## BOOK REVIEWS

*Animal Nutrition and Veterinary Dietetics* (4th Edition) by John T. Abrams, M.A., M.Sc., Ph.D. Edinburgh: W. Green and Son Limited, 1961. Pp. 826. Price 84/-

Animal nutrition is a subject that embraces both theoretical and applied aspects. To cover this broad field, and to produce a book which can give a clear picture of both phases of the subject, is a difficult task. Dr. Abrams has attempted this and has succeeded to a remarkable degree.

*Animal Nutrition and Veterinary Dietetics* is well written. References include a good cross-section of world literature and are not biased toward work done in Britain and Europe. North American readers may experience some difficulty in reading the text because of differences in terminology and feeding standards.

A nutritionist would definitely favour a book such as this because it gives one author's views of the broad field of animal nutrition and feeding. From the standpoint of the practising veterinarian, however, it might have been wise to have produced the book in two volumes: the first covering basic nutrition and the second, which could be much smaller and less technical, containing the applied aspects. The second volume would then be a handy reference work for the veterinary practitioner.

*Animal Nutrition and Veterinary Dietetics* is a commendable nutrition and feeding text-book and will be of increasing importance for large animal veterinary practitioners who must, in the future, know more about animal nutrition and management.—D.C.M.

*Poultry Production* by Leslie E. Card, Ph.D. Toronto: Macmillan of Canada, 1961. Pp. 409

As indicated by the author, this book is not intended to be used as a poultry practice manual. It is written as a textbook for poultry husbandry students in agricultural colleges in the United States. Much of what is said has to do with basic, fundamental information and applies also to Canadian poultry production. An interested and intelligent poultry man might find this book helpful in understanding the principles of poultry science as they apply to his business. However, most of the practical information on brooding, rearing, feeding, marketing, housing, and equipment is already available from government and other sources.

For students of poultry husbandry, this book is an excellent source of specific information on many subjects concerned with poultry. The sections on the endocrine system and genetics as they relate to poultry production are particularly good. Poultry nutrition is discussed in considerable detail. Other areas are covered only in a general way. This is true for the most part of the chapter on diseases and parasites, and the discussion on the business of poultry farming.

Dr. Card devotes a good deal of space to relating the results of research and newer knowledge in the field of poultry science to practical poultry production. He also discusses the reasons for many of the practices which are in common use today.

No reference is made to turkey raising or any type of poultry except chickens.—R.J.J.