

In a previous paper, I discussed the problem of shivering as met with in three old horses and expressed the opinion that an investigation of the condition in young horses might throw more light on its cause.

In the old horses which I examined, gross changes of an ostéo-arthritis nature were the outstanding features, especially in the vertebral column, and I suspected that the signs of shivering might be due to pressure effects on the roots of the nerves going to form the lumbosacral plexus. Since then, I have been able to examine, post-mortem, three definite shivers, aged 2, 4, and 5 years respectively, and again ostéo-arthritis has been a prominent feature, though there were no marked exostoses on the vertebrae which one could incriminate as possibly causing pressure on lumbar or sacral nerve roots.

In all I found synovial of the costo-vertebral articulations with varying-sized erosions of the heads of ribs from the effects of synovial overgrowth in three joints. The hip, stifle, shoulder, elbow and (tho-tartar) joints showed some degree of early arthritis, though the joints from the fetlock downwards showed no appreciable change.

The erosion of joint surfaces occurs more especially in areas which anatomists have considered as normal excavations on joint surfaces, but in some joints, particularly the elbow joints, in addition to synovial congestion and overgrowth of cartilage, erosion of the articular cartilage was visible. In other joints, epochondritis, or merely a yellowish degenerate change of articular cartilage, may be observed.

The point I wish to stress is that I have yet to examine a shiverer, young or old, in which there is no osteo-arthritis.

The difference between old and young horses affected with shivering is, that in old horses there is marked evidence of nature's effort to repair joint damage by bony and cartilaginous hyperplasia seen as well as a lipping of the articular surfaces of many joints.

An extraordinary thing, to my mind, is the absence of lameness in all the shivers I have seen, though gross pathological changes are to be found in many joints, and this holds for many horses other than shivers.

Another feature closely allied to ostéo-arthritis, which has been met with in the three young shivers already mentioned, is the presence of well-marked ulcers, the 4-year-old showing complete ossification of all cartilages. (Specimens exhibited.)

I think I can assert that a horse which is a shiverer will always show some evidence of ostéo-arthritis, either clinically, or at post-mortem examination.

Post-mortem.-In the case of the 4-year-old, while examining the right hip joint, I found there was a partial disintegration of the accessory ligament and, following its course in the groove on the ventral surface of the pubis, I was surprised to find that the periosteum over the ventral surface of the pubis was completely detached from the bone. There was no evidence of any hamartoma between the bone and the periosteum.

When I came to examine the sciatic nerves just behind the hip joints I found marked haemorrhages and oedema around the nerves which were connected with similar fractures of both sciatic tuberos. On feeling out the hip bones (specimens exhibited) a fine deposit of new bone can be seen over both dorsal and ventral surfaces of the pubis and ischia. You will see from the specimen that the fractured portions are only small similar detachments, as if the fractures were due to a pathological condition of the bone associated with excessive muscular action.

Haemorrhages.-In such diverse situations as the loose connective tissue between the external and internal oblique abdominal muscles, and the fat-loaded connective tissues in the neighbourhood of the elbow and stifle joints, groups of petechial haemorrhages have been noticed.

Diffuse haemorrhagic areas are common in the retroperitoneal fat, but there are always in the vicinity of encysted larval sclerostomes. A serous semi-encysted cyst has frequently been seen in the sub-angular muscles near the points of origin of the muscle fibres from the bodies and transverse processes of the lumbo-sacral vertebræ. It should be remembered that it is in the sub-angular muscles that the marked haemorrhagic infiltration is most frequently found in haemoglobinuria in the horse and that this disease may merely be a very acute form of the disease under consideration.

Lymph Glands.—All the lymph glands are enlarged and have a slightly congested, pink appearance.

Stomach.—In shivers and other ostéo-arthritics the stomach frequently shows ulceration of the mucous membrane, producing in the pyloric portion a marbled appearance, apparently normal areas of mucous membrane being interspersed with irregular ulcerated areas. Ulceration is also present on the subgastric portion of the mucous membrane, usually in the neighbourhood of the marginal incision, sometimes as definite rounded ulcers about the size of a shilling, but in other cases quite a large patch of mucous membrane may be absent.

Large Intestine.—In every shiverer I have examined, young or old, has had a fairly heavy infestation of sclerostomes and, in keeping with this, an angio-sclerosis of the aortic and other branches, and in one case there was a series of small abscesses in the bowel wall each
about the size of a hazelnut, probably due to
 gaining access at the time of entry of a larval form. An
 interesting fact noticed in one horse—regarding these
 parasites was the accumulation of a large number in the
 loose connective tissue between the root of the abdomen
 and the base of the caecum, with slight ulcers and
 appearance of haemorrhage from the resulting irritation.
 Encysted larval forms are commonly seen in the pericardial
 retro-peritoneal fat with an area of congestion around
-interesting fact noticed in one horse
 parasites was the accumulation of a large number in the
 and the loo se connective tissue between the roof of the
 retro-peritoneal fat with an
 organic disease of the heart of
 keeping with the contention I have often expressed that
 disease of the heart of the horse is rare and that in the
 great majority of horses heart disease is functional.
 Larynx. —This has only been examined in the 2 and
 3-year-old horses and in both cases there was atrophy
 of the intrinsic muscles on the left side supplied by the
 recurrent laryngeal nerves; incidentally both these
 nerves were had granules, but no test was made to deter-
mine whether they were roosters during life. This atrophic
 change was of significant when I have dealt with the
 changes in peripheral nerves. (Specimens exhibited.)
 Nervous System.—As I was not satisfied that pressure
 upon nerve roots could account for clinical signs of shivering,
 I became obvious that a more careful examination of the
 nervous system was necessary. So far, I have found
 no gross change in the brain or spinal cord removed from
 the three young shivers, but they have been retained
 for future investigation. In my previous series of cases
 I had already noticed a marked congestion, one might
 almost call it a definite hemorrhage, involving the roots
 of some of the lumbar nerves. I have not seen any such
 change in the three young horses, but examination of
 the sciatic nerves has revealed a varying degree of slightly
 congested cedematous nerve trunk, in marked contrast
 to the pale portion of intervertebral space and bone of
 the affected area. The lesion is a bilateral one. This
 area of the nerve varied from three to five inches in
 length, and in all cases situated just behind the level of
 the hip joint. In the 2 and 4-year-old horses, in addition
to this diffuse pink opaqueness, there were small petechial
 hemorrhages spread throughout a cedematous area.
 A similar bilateral change has also been seen in the median
 and radial nerves on the limbs of the area in the 4-year-
 old, which during life showed inability to flex the fore
 limbs when hobbled, tendency rather to slide the feet back
 along the ground. The latter had no gross hemorrhage
 associated with the apparent fracture of the sciatic
 tendons which I have already described, extending to
 involving the nerve trunk.
 Microscopic Examination of Sciatic Nerves.—In the
 swollen cedematous area the numerous bundles, instead of
 consisting of closely packed nerve fibres, show partial or
 complete isolation of the individual fibres by clear
 spaces with, in recently affected bundles, an overgrowth
 of young connective tissue. In many of the bundles large
 numbers of the fibres have completely disappeared; these
 take to be cases of longer standing and in their place
 is a definite fleshy mass of fully-formed connective tissue
 fibres. I have never seen a bundle in which all the nerve
 fibres have disappeared. The nerves show that a congested
 area may show very little interstitial change beyond a slight
 fragmentation of some of the bundles. For comparison with the affected sciatic nerve of the
 first horse I examined, I obtained what I thought would be a normal length of a sciatic nerve from a horse showing
 no signs of shivering, and to my surprise it showed in a
 number of bundles well-marked, old-standing fibromata.
 Since then I have taken in all a similar portion of sciatic
 nerve from 13 horses with no signs of shivering and of
 these, six specimens have shown varying degrees of
 fibrosis (portions exhibited). The horses, therefore, appears
 to be very liable to an interstitial neuritis. My examina-
tion of peripheral nerves has as far been confined to the
 sciatic nerve, but from what I have described in
 connection with it and the gross changes seen in the
 median and radial nerves, it is very probable that other
 nerves may show similar changes. May not the atrophy
 of the laryngeal muscles in the two horses in which I can
 certify there is an interstitial neuritis of the sciatic be
 due to a similar neuritis of the left recurrent laryngeal,
 and may not the progressive nature of reaction be due to a
 gradual encroaching fibrosis compressing its fibres?
 Miscellaneous Changes in other Tissues of the Horse.—
 Examination of these is not sufficiently advanced to make
 any report in the meantime.
 Provisional Conclusions Regarding Shivering.—Even
 at this stage of a very incomplete investigation, from the
 various pathological facts recorded, it appears to me that
 shivering is merely one of the many local manifestations
 of a general disease from which horses in general suffer.
 I leave it to you to picture to yourselves the numerous
 local manifestations likely to be due to a common path-
 ological factor or factors which at present are diagnosed
 as definite clinical entities.
 Much remains to be done, especially in the histological
 of the disease, in order to understand the beginning
 of the process, and if there are any in breeding districts
 who are able to get me young animals likely to be of interest,
 I will be greatly indebted to them.
 ETIOLOGY
 All I have done so far is to place before you patho-
lological evidence, but now I wish to direct your attention
 to a much more difficult problem—the cause of all these
 changes which can make a horse a very pathological
 animal. From the multiplicity of lesions met with, it
 seems obvious that there must be some factor of a
 toxanotic nature, using this term in the widest possible
 sense, which, if it can be tracked down and eliminated
 might be the cause not only of preventing shivering
 but a whole host of other local manifestations to core
 which generations of veterinary surgeons have devoted
 their energies in equine practice. I will limit myself to
 considering only a few of the possible causes, crossing
 out in particular the factors of diet. Heredity and con-
cussion have been considered important factors, caus-
ing, at any rate, the athenic conditions in the limbs,
 so I will briefly say a word about them first.
 Heredity.—I am prepared to believe that the lack of a
 disease relationship may be of considerable importance
 in all the various conditions scheduled under the Horse
 Breeding Act, 1935, which, however, in my opinion, are
 mostly local manifestations of a general disease.
some might still be said about tabularus, yet how many would now say that it is hereditary? It would be very
surprising to ignore this hereditary disease-resisting factor, whatever it may be, until such time as it is possible to
be certain about the factor or factors which initiate and maintain this hereditary group of parasites and the likelihood of
eliminating it.

Conclusion.—I think this has been overrated as an exciting cause, even of the phlegmonous affections, and
this because I am certain, from numerous post-mortem examinations, that if a horse shows definite clinical signs of
osteomalacia in the limbs, one is certain to find generalised inflammatory changes in other parts of the body,
ot only in the skeleton, but in other connective tissues and microscopically in various organs.

Diar.—I have already drawn attention, in the discussion on the paper already referred to, to the fact that the
same of all domesticated animals lives on the most restricted of diets, hay and oats, and I will briefly sketch the
effect of deficient diets on experimental animals, as I think the results already obtained suggest possible lines of
attack upon the etiology of the common disease under consideration. Millanby, M., has shown that food may
contain protective and harmful elements and I would like to take the opportunity of paying a humble tribute to
her for such a wonderful record of work recently published by the Medical Research Council which will benefit
animals as much as men when its conclusions are fully realised and applied.

The protective substances are the so-called vitamins, for many years now a household word in dietary, but the
word for the substance in question, has only recently been suggested by Millanby. The foods in which these
harmful substances are outstanding are the cereals and the most potent of these is oatmeal. So far, the
presence of two different toxamins has been suggested.

—An Anti-calcifying Toxamin Antagonised by Vitamin D.

Working with dogs, it has been shown that cereals interfere with the deposition of calcifying salts in bones
and teeth, and of all the cereals oatmeal is the worst, and that the embryo of grain has this harmful effect
more developed than the endosperm. It is well-known that grain products are rich in calcium and phosphorus,
but it was found that, in spite of an abundant supply of these salts, if the diet was deficient in Vitamin D there
was a smaller retention of these elements in the growing bones. This points to the importance of not being misled
by chemical analyses indicating high mineral content in foods.

So long as there is an efficient supply of Vitamin D, t he anti-calcifying effect of cereal will be
countered. Does the horse obtain an efficient supply of Vitamin D? The natural sources of this are by way of the
diet or by the activation by sunlight of ergosterol in the skin. In the majority of horses the Vitamin D in the
diet is calculated to the decalcifying effect being smaller than that which the diet contains. The amount of Vitamin D derived from
the skin, especially in the winter in this country, will not be insignificant, and the conditions of stabling add still further to the depredation, but, on the other hand, horses in
Egypt and India suffer as much from osteo-arthritis as in this country, where there is no lack of sunlight. Green
rice, such as we get in the tropics and in

in the horse. It is, therefore, very doubtful whether Vitamin D-deficiency is of much importance in the horse.

—A Calcium Causing Degenerative Lesions in the Spinal Cord Antagonised by Vitamin A.

Millanby shows how cereals fed experimentally to dogs may produce severe intra-ordination of movement often
associated with and followed by weakness of the hind legs, and that this appears to be due to a lack of Vitamin A.

Again, oatmeal has been shown to contain this toxic substance acting on the nervous system. Timothy hay
is said to contain Vitamin A in considerable amount, and I expect that other kinds of hay are equally efficient,
but in a recent article by Professor Millanby, Vitamin A is said to be a very unstable substance and apt to
disappear rapidly, especially in high concentrations, so that the content in hay must be considered doubtful.

Possibly some of the nervous signs seen in cholerinic may be associated with the Vitamin A deficiency allowing a toxamin
of oats to exert its harmful influence.

Is the Horse a Victim of Scurvy?

The basic fact of the horse is essentially a dry one which is deficient in Vitamin C, the vitamin present in roots,
grass and various fruits, which is said to be very effective, even of the phalangeal affections, and to have a
response time much sooner than that of cereals when applied. When bones are deficient in Vitamin C, as is the case
with horses, it has been shown that cereals have a marked anti-calcifying effect, and this will be discussed
more fully in another connection.

REFERENCES.


