

THE ETIOLOGY OF LOUPING-ILL.

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THE investigations of recent years furnish many examples of striking improvements in methods of treatment and prevention which have flowed from an accurate knowledge of the causation of disease. It is true that the history of medicine also shows that important advances in the treatment of particular diseases have sometimes been made at a time when knowledge regarding the etiology of these diseases was obscure or altogether erroneous, but such cases are exceptional, and it may be said that, in general, attempts to discover a method of curing or preventing a disease are of the nature of gropings in the dark so long as nothing is known definitely regarding its causation. It therefore follows that all new discoveries with regard to etiology ought to be hailed as the possible forerunners of improvements in prevention or therapeutics, and it also follows—though this is sometimes lost sight of—that the promulgation of false views regarding etiology are baneful, because, when they are accepted, they tend at once to stifle further inquiry concerning causation and to give a false direction to the search for remedies. There are not lacking indications that this dangerous state of affairs exists at the present time with regard to the ovine disease known as louping-ill. In the following pages I propose to examine the views regarding the etiology of the disease which have been put forward within recent years, and to consider the alleged evidence on which they are based.

First of all, it is fitting to ask, What is louping-ill? It is unfortunate for the settlement of any controversy regarding the etiology of the disease that no very precise answer to this question can be given. When the cause of a disease is not certainly known it can only be recognised by the symptoms or lesions that are peculiar to it, and it has to be confessed that it is well nigh impossible to construct from the published views of those who have written on the subject a distinct clinical picture of louping-ill, or to figure to oneself the *post-mortem* appearances that are characteristic of the disease.

The term louping-ill appears to have come into existence among farmers and shepherds in the Border districts of England and Scotland, and it has been current among them for a century or more. It is therefore natural that one should turn to them for information as to what kind of disease it is, and how they recognise it and distinguish it from other ovine complaints. The result of such inquiries is very disappointing. In my own investigations regarding louping-ill I had the assistance of sheep-owners and shepherds who had spent their lives in localities where the name was current, but I found that in spite of their long experience they mixed up, under the term louping-ill, diseased conditions that were quite different in respect of symptoms and lesions. That this lack of precision in the use of the term louping-ill is not of recent origin is shown by the description of the disease which Fair gave in *The Veterinarian* more than sixty years ago.¹ After describing what he regarded as the usual symptoms,

¹ Vol. XII., 1839.

he concluded by saying that, "the disease does occasionally assume so many different forms, although each is more or less connected and allied with the other, that the most skilled veterinary practitioners may for a while be puzzled to say whether it is most akin to tetanus, apoplexy, or palsy." It may be observed that Fair also described lesions, such as tumours containing pus or ichor, and abscesses about the joints or elsewhere, which are in no way suggestive of any of the three morbid conditions which he mentions.

It is true, however, that Fair appears to have attached most importance to symptoms of nervous disturbance, such as convulsive fits, spasmodic contraction of various groups of muscles, and paralysis, and in this he has been followed by most modern authors, including Professor Williams.

The last-named author's accounts of his investigations contain incidental corroboration of what has just been said with regard to lack of precision in the use of the word louping-ill by experienced laymen, for he records instances in which his *post-mortem* examinations showed that sheep sent to him for the purpose of his investigations were found to be the subjects of other diseases. Moreover, he admits the difficulty which attends investigations in view of the frequent absence of characteristic lesions, and he states that "in the majority of the animals examined after death no really characteristic lesions could be detected. In many, all parts of the body presented the appearance of health, death having been evidently due to intense nervous irritation."¹ At the same time, he appears to attach much importance to the presence of a lesion which he found in many cases of the disease. He says:² "In some instances there is a jelly-like formation in the spinal canal, external to the *dura mater*, sometimes extending in a more or less uniform layer from one end of the canal to the other, but rarely extending within the cranium. It is sometimes in patches here and there, particularly embracing the roots of the spinal nerves; generally there is a long patch in the lumbar region, then smaller ones scattered along the dorsal region; often a large patch at or about the junction of the cervical and dorsal, and very frequently a large and much redder patch immediately posterior to the foramen magnum or entrance into the brain cavity." This jelly is described as a slimy tenacious substance of a straw colour, and it is said to have been seen in oxen as well as sheep and lambs. "It is, however, not constant, even in cases that have been unwell for several days, whilst in others that have been down three or four days it is abundant."

Since Professor Williams himself admits that this material is not constantly present in cases of louping-ill, and even that the majority of the animals examined by him "presented all the appearances of health," it is obvious that the *post-mortem* diagnosis of the disease must be generally impossible in the absence of a clinical history. It would have been something gained if it had really been shown that even in a minority of cases there is a characteristic lesion within the spinal canal, but, unfortunately, Professor Williams' alleged discovery in this connection has not been corroborated, and will not bear examination. Originally this extra-dural jelly-like substance was

¹ "Principles and Practice of Veterinary Medicine," 1890, p. 32.

² *Loc cit.*, p. 33

regarded by him as a bacterial product—a sort of zoogloea, but there is room for more than a suspicion that what he was describing was in reality the normally present adipose tissue of the spinal canal in a state of oedema. At any rate, the description quoted above would stand as fairly correct for cases examined by myself, but the “slimy tenacious substance” lying outside the *dura mater* was quite obviously fat which had undergone the so-called “serous atrophy.” It is worthy of notice that in Professor Williams’ cases this material, like the normal extra-dural fat, was not continued within the cranial cavity.

To sum up our knowledge with regard to the symptomatology and lesions of what is termed louping-ill, it may be said that neither by the one nor the other is it possible to say with certainty whether a given animal is the subject of the disease or not.

What may be called the “tick theory” of the causation of louping-ill appears to have been for a long time current in those localities in which the disease is most prevalent, and it is impossible to say with whom it originated. Only vague notions would appear to have been held as to the rôle played by ticks in the causation of the disease, but it was believed that there was some connection, since, it was alleged, the disease was rarely if ever met with apart from the presence of ticks on the sheep. It was mainly in the south of Scotland that the tick theory found acceptance, and in Galloway no such connection had suggested itself to sheep-owners.

In the year 1879 the Teviotdale Farmers’ Club appointed a Committee to investigate the cause of the disease, and in this report, issued in 1884, the Committee stated that while in most cases ticks were found where the disease prevailed, this was not universally the case. They added that they found it difficult to believe that the effect of the ticks could be more than indirect, “either as carriers of the poison or as exhausting the stamina of the sheep and making them more liable to disease.”

The “Transactions of the Highland and Agricultural Society” for 1882¹ contain the first report of a Committee appointed by the Society to enquire into the diseases known as louping-ill and braxy. Professor Williams was a member of this Committee, and the report contains an account of his observations with regard to the symptoms and lesions presented by sheep affected with so-called louping-ill. He found that several different ailments received this name, and he considered that poverty or starvation was the cause of most of the losses attributed to the disease. At the same time, he satisfied himself that, apart from such conditions as joint-ill, navel-ill, wool in the stomach, etc., “a disease of the nervous system really has an existence, and prevails extensively among lambs, and still more so amongst full-grown sheep, occasionally attacking cattle, and said also to attack pigs.” In was in the course of this inquiry that Professor Williams first observed the jelly-like substance external to the spinal cord, which he described as being composed of “cells and tubes, the nature of which are not exactly yet determined, and will require further examination and experience.” At the same time, he was led to form the opinion that the disease was due “to the injection (ingestion ?) of grasses in a diseased condition from the invasion of various fungi.”

A second report by the above-mentioned Committee appeared in

¹ Appendix, p. 39.

the "Transactions of the Highland and Agricultural Society" for the following year.¹ The Committee in the course of their further inquiries had found that ticks might occur without louping-ill, and they had been informed by several farmers that louping-ill occurred on their land although there were no ticks. This latter statement was accepted with the reservation that possibly these cases not associated with ticks might turn out not to be true louping-ill.

Accompanying this report by the Committee was a special independent report giving the results of Professor Williams' own investigations carried out concurrently. In alluding to this latter report the Committee stated that they desired to speak with all caution regarding the purely scientific portion of it, "but considering the very delicate and difficult nature of such an investigation, and by means of cultivations, it would be highly satisfactory, and in this Professor Williams readily concurs, that his experiments should be corroborated by other observers, and also that the life history of the tick should be fully worked out." As will presently appear, the Committee undoubtedly had good grounds for this attitude of reserve with regard to the methods of Professor Williams' investigation and the conclusions at which he arrived.

It was in the report here referred to that Professor Williams first claimed to have elucidated the etiology of louping-ill. His account of the pathology of the disease may be summed up by saying that in his view louping-ill is a bacterial affection caused by a micro-organism which is to be found in great numbers in the jelly-like substance external to the spinal cord, and the tick is a necessary agent in infection—"firstly, by the infected tick fixing itself in the skin, thus directly inoculating the higher animal; secondly, by the ingestion of ticks (which in their earlier stages abound in the grasses), the organism gains access into the system, particularly if any portion of the mucous membrane of the digestive apparatus be abraded."

It is a little difficult to subject to serious criticism and analysis the series of observations and experiments on which these conclusions were based. Briefly stated, they were as follows:—

- (1.) The jelly-like substance found in the spinal canal showed on microscopic examination large numbers of micro-organisms.
- (2.) Ticks taken from diseased sheep were dropped into cultivation vessels containing bouillon (mutton broth), and there was then obtained an artificial culture containing "numerous bacilli or rod-like bacteria, in no respect distinguishable from these present in the fluids from the diseased sheep."
- (3.) "Ticks were obtained from perfectly healthy sheep and treated in the same way," with the result that "the same organisms were found to be developed, but not quite so quickly, in the cultivation, as in that containing the tick from sheep suffering from louping-ill."

As has just been said, it is somewhat difficult to treat these so-called investigations seriously, but, unfortunately, they cannot be passed over in silence when they are still being put forward as evidence good enough to satisfy sheep-owners that there is no longer anything obscure about the cause of louping-ill.

Dealing in the first place with the alleged presence of micro-organisms in the jelly-like substance found in the spinal canal, it

¹ 1883, p. 176.

deserves to be noted that the description of the micro-organisms was supplemented by drawings, representing their appearance under the microscope, but it cannot be said that these afford much assistance to the reader. It may, however, be asserted that there is no known organism like them, though the larger things figured do bear some resemblance to blood capillaries such as are present in the extradural fat.

On the other hand, the accompanying figure of the organisms found in the artificial cultures show leptothrix filaments, bacilli of varying dimensions, micrococci, and what are probably the hyphæ of some fungus. None of these present any close resemblance to the filaments figured in the drawing from the jelly-like exudate, and they differ so much among themselves as to leave no room for doubt that the cultivation was an impure one.

As to the experiments involving the incubation of whole ticks in bouillon, and the conclusions drawn from them, perhaps the less said the better. Putting aside the crudeness of the methods, which made it impossible to attach any importance to the results one way or another, it will be observed that had a conclusion been admissible in the circumstances it ought to have been precisely the opposite of the one drawn by Professor Williams. There could hardly have been any other object in comparing cultures obtained with ticks from diseased and healthy sheep than to show that the bacillus alleged to be the cause of the disease was not present in ticks found on healthy subjects, and when the experiment indicated that it was present in ticks from healthy sheep it ought surely to have been concluded that the bacillus in question had nothing to do with the disease.

These earlier investigations by Professor Williams into louping-ill may be dismissed by saying that they left the etiology of the disease just as obscure as before. Although it is not taking events in chronological order it may be advisable to examine in the next place the results of a more recent investigation of the disease by the same author.

Professor Williams' most recent contribution to the subject¹ is prefaced by the statement that in December 1893 he was requested by the Highland and Agricultural Society to conduct further investigations and experiments to determine whether his former investigations, carried out in 1881-82 could be borne out or contradicted, "some writers having expressed great doubts as to the correctness of his conclusion, others going so far as to state that they had not been laid on a scientific basis." The clinical observations reported in this article do not call for examination, as they do not furnish any new material on which to base a conclusion regarding the precise causation of louping-ill. There are, however, certain experiments which require to be noticed.

The first of these took the form of an attempt to infect a sheep with an artificial culture, and the account of the experiment is given as follows:—

"1894, May 2. Sheep inoculated at 3.25 P.M. with cultivation from sheep killed at Brown's farm, Dalmally, whilst suffering from louping-ill. Temperature 103° F.

¹ "Transactions of the Highland and Agricultural Society," 1897, p. 278.

"May 3. Temperature 102° F.

"May 4. Partial paralysis of the fore-limbs; convulsive twitchings or 'trembling;' foaming at the mouth. Temperature 102° F.

"May 5. Complete paralysis of the fore-limbs; partial paralysis of the hind limbs; convulsive movements, etc., increased. Temperature 104° F.

"May 6. Sheep died, 8 A.M. *Post-mortem* revealed louping-ill lesions."

The account of this experiment is quoted at length, lest it should be thought that some material fact was here omitted. It must be obvious, even to a layman, that the experiment proves nothing with regard to the etiology of louping-ill. In the first place we are not told what was the nature of the culture—what material from a louping-ill sheep was used to start it, what was the age of it, or what kind or kinds of bacteria were present in it. It was, apparently, a first culture, and no steps appear to have been taken to ascertain whether it was pure. Again, no information is given as to the quantity of culture introduced, or the seat of inoculation. The sheep became very ill on the second day after inoculation, and it died on the fourth day. We are told that the *post-mortem* revealed louping-ill lesions, but nothing is said as to the lesion, if any, at the seat of inoculation, and no bacteriological examination of the dead animal appears to have been made. Taking all the omissions into consideration, and having regard to the impossibility of diagnosing louping-ill from simple *post-mortem* examination, the guess may safely be hazarded that this sheep, if it succumbed to the inoculation, died from septic infection and not from louping-ill.

The report next describes an unsuccessful attempt to infect six sheep by placing on them from ten to fifteen living ticks, taken, presumably, from sheep affected with louping-ill; and it continues with an account of inoculation experiments with "cultivations from ticks." Here, again, no particulars are given as to the method by which the cultures were obtained from the ticks, their age, the quantity injected, or the bacteria present in them. As regards the methods of cultivation, it may be surmised that this was a repetition of the original attempt to obtain the germ of louping-ill by catching live ticks, with all their outward and inward contamination, and dropping them into flasks of bouillon. Six sheep were inoculated in this way (one of them twice), and the results were negative in each case.

It is worthy of notice that while Professor Williams admits the failure of these attempts to communicate the disease by putting ticks on healthy sheep, or by inoculation with artificial cultures started from ticks, and the consequent necessity of modifying his experimental methods in order to prove the rôle of the ticks, he has not a line of comment upon the first experiment—the one in which a sheep died with louping-ill lesions four days after it had been inoculated with an artificial culture started from a case of louping-ill. He would hardly himself contend that the result of this one experiment was very conclusive, and it appears singular that it was not repeated. One is at a loss to understand why he did not continue his cultures in series from the tube used successfully to infect a sheep, and by repetition of such inoculation experiments accumulate irresistible proof that he had actually got hold of the bacillus of louping-ill.

In view of the negative results of the above-mentioned experiments

with ticks and cultures obtained from ticks, Professor Williams resolved to adopt another line of procedure in the future, viz., to send healthy sheep to tick-infested districts, to muzzle the experimental animals so to prevent them from grazing, to feed and water them indoors with food brought from elsewhere, and after a time to have them brought back to the Veterinary College for observation. This plan was put into operation in 1896. Four sheep were thus exposed on a louping-ill farm from the 22nd to the 30th April, and on the latter date they were returned to Edinburgh. Three of them then appeared to be well, but one of them "had tremors about the jaws, and seemed in a dazed condition." These symptoms passed off, but they reappeared, and she became paralysed on the 25th of May, and died on the 28th. The *post-mortem* examination revealed "the characteristic jelly-like myxœdema, . . . the jelly containing the characteristic organisms well developed."

On the 28th April, twelve living ticks sent from a louping-ill farm were placed on a sheep at the College. After ten days the sheep commenced to manifest symptoms of louping-ill, and it died on the twelfth day after the ticks had been placed on it. In this case there was little or no jelly-like exudation in the spinal canal, but around the heart there was a considerable amount of effusion of serum, which was "found to contain abundance of the characteristic organism."

On the 8th May, another of the four sheep brought back from the louping-ill farm on the 30th April became unwell, and paralysis set in on the 12th. It died on the 17th, and the *post-mortem* examination "revealed the characteristic jelly-like exudate in the spinal canal, which on microscopic examination were found to contain well-developed mycelium and spores of the organism."

From the 13th to the 21st May, another lot of sheep, ten in number, were exposed in the muzzled condition on a louping-ill farm. They were brought back to Edinburgh on the 21st May, and on the 27th May, the sheep then appearing to be healthy, they were inoculated with cultivation material from the spinal canal of a sheep which had died on the 12th, the material being "filled with the well-developed organism." One of these five sheep remained healthy, but the three others died—one on the 29th May, another on the 1st June, and the third on the 5th June. Although the "characteristic appearances" were not present in these cases, the deaths were attributed to louping-ill, "and the organism could be detected microscopically and cultivated in the usual way."

Such, in outline, are the more recent experiments which are held by Professor Williams to establish the claim he put forward in 1883 to have discovered the germ of louping-ill. As in the case of his earlier investigations, the evidence must be pronounced quite insufficient. It is obvious that the experiments in which muzzled sheep were turned out daily in what may be called louping-ill land, prove nothing whatever regarding the bacterial origin of the disease, nor can they be held to establish the alleged rôle of ticks in infection. The whole of the experiments are vitiated by the assumption that the œdematous condition of the adipose tissue around the cord is diagnostic of louping-ill, and those in which inoculations with artificial cultures were practised are also deprived of all value by the absence of details concerning such matters as the original source of the culti-

vation, the generation of the culture used to infect, the seat of inoculation, etc. It will not have escaped notice that these artificial cultures were of a very virulent character, the one used on the 2nd of May 1894, killing the sheep in less than four days, while that employed on the 12th May 1895, caused the death of one of the experimental sheep on the second day after inoculation. It is not pretended that in this case there was any resemblance to louping-ill in point of symptoms, and it is even admitted that "some septic blood-poisoning" was at first suspected. It appears highly probable that that was the actual cause of death, and that the activity of the cultures employed depended upon the presence in them of putrefactive organisms, obtained from carcasses that were not quite fresh at the time of examination.

The account of these experiments is accompanied by a number of illustrations representing bacteria alleged to have been present in looping-ill lesions, and in artificial cultivations obtained from ticks and from the spinal fluid and heart blood of sheep dead from louping-ill. Inspection of these illustrations does not tend to increase one's faith in the reliability of the experiments. Scarcely any two of them appear to represent the same organism, though presumably they are put forward as examples of the louping-ill bacillus, and one of them (Fig. 61) is an obviously impure culture containing large leptothrix filaments and one or more species of minute bacteria. Finally, it is not possible to trace any close resemblance between the organisms figured here and those which accompanied the article published in 1883.

In 1893 Dr Klein, the eminent bacteriologist, investigated louping-ill as it occurs in Northumberland, and the results of his researches were published in the journal of the Royal Agricultural Society for the same year.¹ These do not call for a lengthy examination, as Dr Klein did not claim to have solved the etiology of the disease. From the bodies of sheep dead of louping-ill he was able to cultivate a number of different bacteria, but only one of these was thought to have any claim to be considered as in any way related to the disease. This was a small bacillus which was cultivated from the cerebral fluid of six cases (out of seventeen examined), and also from the lung of two of them. Subcutaneous inoculation of an artificial culture of this bacillus did not produce any serious effects; and a like negative result was obtained in two inoculation experiments, practised on lambs, with the cerebro-spinal fluid of a sheep killed at an early stage of louping-ill. It may therefore be said that Dr Klein failed to produce any precise evidence as to the actual cause of the disease, and his experiments even went some way to prove that it is not bacterial.

Almost simultaneously with Dr Klein's investigations, a number of observations and experiments bearing on the etiology of louping-ill were made by me, and the results were afterwards published in this Journal.² The general conclusion arrived at was that a number of perfectly distinct diseases are grouped together by sheep-owners and shepherds under the name louping-ill. The cases actually observed by me could be arranged under three heads, viz.,

1. Pyæmic spinal meningitis, caused by pyogenic bacteria.
2. Gastritis and enteritis from indigestible substances (wool, sand, dried grass) in the stomach or intestines.

¹ Third Series, Vol. IV., p. 625.

² Vol. VII., p. 207.

3. Disorders of brain functions, paralysis, and general weakness, with, in some cases, excess of cerebro-spinal fluid in the cranial cavity, but without gross lesions in any of the organs of the body.

The third of these groups included most of the cases in adult sheep, and the term louping-ill may be narrowed down to include only such cases as exhibit these nervous symptoms, though it is quite possible that even then it would cover cases that are etiologically distinct. My own experiments, like those of Dr Klein, failed to elucidate the pathology of the cases included in this group, but they indicated that these cases are not bacterial, or, at least, not transmissible by inoculation with the blood, cerebro-spinal fluid, pericardial fluid, or spinal cord of diseased animals.

Messrs Greig-Smith and Meek make some investigations regarding louping-ill, and studied the life-history of the ticks found on sheep.¹ They cultivated a number of different bacteria from sheep supposed to have been affected with louping-ill. On the ground of paralytic and other effects produced by certain of these cultures on rabbits, the authors appear to have been inclined to think that they had discovered bacteria causally related to louping-ill, but there is nothing in their experiments to justify such a conclusion. Even when consideration is confined to the ovine species there is plenty of room for error in diagnosing louping-ill from the symptoms exhibited, but the possibilities in that direction are immensely increased when one takes symptoms as a basis on which to diagnose the disease in such animals as rabbits.

This review of recent literature on the subject of louping-ill would be incomplete without a reference to an article by Mr E. G. Wheler, entitled "Louping-ill and the Grass Ticks," which appeared in a recent number of the *Journal of the Royal Agricultural Society*.² The article starts with the assumption that the disease is caused by a bacillus which is inoculated into the sheep by ticks, and it records a number of observations regarding the life-history of these parasites. The writer appears to be under the impression that there is a close analogy between louping-ill and the so-called Texas fever of cattle, and he considers it probable, judging from analogy, "that the bacillus can only be obtained from a diseased sheep, and inserted by the tick into another sheep," and "that the ticks convey the bacillus through their eggs to their offspring, as well as retain it through their metamorphoses." Regarding this theory, it may merely be remarked that it will be time enough to construct theories to explain the method of infection or inoculation in louping-ill when it has been shown that the disease is a communicable one. It cannot be correctly said that there is the most distant analogy between Texas fever and louping-ill. The observations and experiments of Dr Theobald Smith have shown that Texas fever may be communicated with deadly certainty by inoculating healthy cattle with the blood of an animal suffering from the disease, and that the cattle tick is the instrument of inoculation in the natural transmission of the disease. But there is no similar proof in the case of louping-ill. There is not an atom of trustworthy evidence that louping-ill is transmissible by inoculation with cerebro-spinal fluid, spinal cord, blood, or any other material

¹ "The Veterinarian," 1897, p. 251.

² 1899, p. 626.

taken from the *fresh* carcase of an animal dead of the disease, and there is already a good deal of evidence that it is not so transmissible.

To sum up the present state of our knowledge regarding louping-ill, it may be said that its etiology and pathology are still quite obscure. No good purpose can be served by shutting one's eyes to this fact, or by constructing elaborate theories on the merest scraps of evidence. The disease demands a painstaking re-investigation at the hands of some competent pathologist, or better still, by some Committee, including one or more pathologists. An investigation at the hands of even the most competent persons might fail to discover the actual cause of the disease, but if it were properly conducted it could not fail to settle some important points that are now the subject of controversy. Chief among these is the question of its transmissibility. If the disease is a bacterial one, and caused in natural circumstances by the bites of ticks, it is perfectly plain that a hypodermic syringe can replace the tick in an experiment. The suggestion, originally made by Professor Williams, that direct inoculations from diseased sheep might fail because the bacillus required some intermediary host between sheep and sheep, is one for which no support can be found in any ascertained fact in the whole range of bacteriology. The cattle tick is in one sense an intermediary host of the parasite of Texas fever, but in another sense it is merely an inoculating instrument, and a hypodermic syringe acts just as well in the hands of man. This applies equally to the disease which is propagated by the tsetse fly. If, therefore, louping-ill is a bacterial disease, there is no doubt that the fact of its transmissibility can be experimentally demonstrated, and if properly planned experiments failed to transmit it one would have to accept the failure as evidence fatal to what may be called the germ theory of this affection.

THE STRUCTURE OF A QUADRUPED'S PATELLA, AND THE POSSIBILITIES OF THIS UPON FRAC- TURE, WHEN COMPARED WITH THAT OF MAN.

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IT is my intention in this paper to bring forward evidence to show that the statement that the patella is broken by indirect violence in animals, found in all veterinary text-books, both foreign and British, is probably untrue. In order to make this clear, it is necessary to briefly recapitulate what I have already said on the subject.

In the *Lancet*, 1st October 1898, I drew attention to the comparison of fractures and dislocations in man and animals, and the influence of the bipedal and quadrupedal positions on them. In this paper the mechanical conditions of the quadruped's patella were pointed out, and these may be briefly summed up as follows. Owing to the natural position of flexion of the knee the weight of the body will tend to increase this flexion. This tendency is resisted by the extensor arc of the joint, viz., the quadriceps extensor muscle, the