POLIOMYELITIS IN SHEEP SUFFERING FROM "LOUPIN' ILL"¹

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(PLATE III.)

THE terms "Loupin' Ill" and "Trembling," as used popularly to designate a single disease of sheep in Scotland, and which imply the exhibition of nervous symptoms, in reality cover several diseases of very different ætiology.

During the spring months of the last two years we have been working at this condition and have been able to separate out several pathological entities denominated by this clinical term. They include one which for ease of discussion we will term at the outset poliomyelitis.

In the districts and in the seasons in which we studied "Loupin' Ill" we found that the term, in at least 95 per cent. of the cases, signified "Navel" and "Joint Ill." These conditions of course occur only in lambs. Here abscesses, pyæmic in nature and secondary to infection of the navel, disintegrate joints and press on the spinal cord, thus causing lameness and paralysis. These abscesses are due to staphylococci, Preisz-Nocard bacillus, and other organisms. The frequent occurrence of such conditions rendered the elucidation of our problem very difficult. We had set out to discover, if possible, the cause of a paralytic affection of obscure ætiology which we believed to have a separate existence, but which was always being confounded with this "navel" and "joint ill." Thinking from the symptoms that we had a case of the obscure condition on hand, we would often, as the result of an elaborate post-mortem, find in the existence of a large abscess of the vertebræ a simple and sufficient explanation of the

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symptoms. We may state that we have seen diagnosed by competent shepherds and farmers as "loupin' ill" in lambs such conditions as a hæmorrhage into the spinal cord at birth, a thorn in the foot, tapeworm cysts in the cord (in older lambs), wool ball in the stomach, pyæmic abscess in the liver, lungs, and heart, and pneumonia. The last three simulated the comatose stage of the disease, the first-mentioned the chronic form or sequelæ of the disease. On the other hand, we have several times examined what we thought was a simple case of "joint ill," and when a post-mortem had been completed rather hurriedly and without any attempt at bacteriological asepticity, we have realised too late that the condition was probably one of the obscure disease we were seeking. So distracting were such occurrences that we resolved to discontinue the further study of the subject in lambs, and turned our attention to a study of the disease in hogs and older sheep, thus eliminating many of the errors incidental to the investigation as conducted on lambs. By so doing we have been able to establish the existence in sheep of a definite clinical and pathological entity, which we describe below. By comparing this condition further with our findings in lambs, we have been able to establish the separate existence of this disease in lambs as distinguished from the other conditions mentioned above, which are liable to be confounded with it.

Even in old sheep, however, on rare occasions conditions of simple pathological explanation may be met with which simulate closely the obscure disease. Thus we have had sent to us, diagnosed as a typical case of "loupin' ill," a sheep with a tapeworm cyst in a silent area of the brain. There is also a disease occurring in newly bought in, highly fed rams in September and October, characterised by inflammation of the respiratory passages and which has been designated by farmers as "loupin' ill." We are at a loss where exactly to place this condition, as although we have seen many of these cases we have not noted in any of them nervous symptoms beyond the nervous prostration and weakness incidental to a grave respiratory inflammation.

The disease which we designate as poliomyelitis of the sheep has a prodromal stage in which the animal exhibits the symptoms associated with the febrile state. The temperature of the animal is raised; it does not feed; it separates from the flock; it hangs about, mopes, and is listless, is constipated, and has usually signs of slight respiratory catarrh, exhibited chiefly by slight running at the nose. During this stage the disease is very difficult to diagnose, and can only be suspected if other animals of the flock are in a more advanced condition of the disease. The disease is, however, declared when the nervous symptoms appear; but even here one has to guard against mistaking a state of profound general weakness for a definite paralysis. This error is especially liable to happen in very fulminant cases of the disease. At the onset of the nervous symptoms, in the general run of the cases, the animal becomes very excitable and alert. It starts at

the slightest noise, and has a staring, agitated look in its eye. On the approach of a man or dog it becomes very restless, stepping from one foot on to the other. It begins to tremble all over. If watched closely, its lips, eyes, and ears may be seen to be twitching. There may be champing of the jaws and frothing of the mouth. If moved about the pen and further disturbed, it sometimes stands up with its eyes rolling in its head, the animal swaying from side to side as if it would fall. If urged to move on at this stage its gait is reeling, and in going through a gate it frequently staggers against the gate-post. The animal may exhibit epileptic symptoms. Again, it may lie on its side in a semi-comatose condition, with its feet moving rhythmically as if galloping, until it has worn out a trench in the ground. By throwing itself about it may break off a horn. Tonic spasms such as opisthotonos are frequently seen. All these symptoms are much aggravated when the animal is disturbed and much diminished when the animal is kept quiet. Indeed, one of the chief measures in the treatment of the disease is to avoid disturbing the animal. This stage just mentioned might be described as the stage of excitation. It may give way to a stage of deep coma and death, or may go on to the chronic stage of the disease with paralysis affecting various muscles and groups of muscles. These paralyses may be of the upper neurone type associated with spasticity, or of the lower neurone type associated with flaccidity. They give rise to various deformities and altered modes of progression in the animal. Among these may be mentioned lameness in one or more limbs, torticollis, "swing-back,"—a condition in which the hind-quarters swing from side to side as the animal runs along—total paralysis of the hind-quarters, with a seal-like mode of progression, sometimes associated with paralysis of the bladder and rectum, total paralysis of all the limbs, so that the animal lies inert on its side, and will sometimes continue to live for months provided it is dragged at intervals to a fresh piece of pasture.

Undoubtedly many cases never go farther than the prodromal stage. It is never known that they have been ill, because, under the conditions under which the sheep live—widely scattered over the hill-side—it is usually only when some nervous symptoms appear that they are noticed to be ill. Many die in the excitation stage of the disease from the violence of the convulsions. Others die from respiratory paralysis or from complications. Some, even after nervous symptoms have developed, recover entirely, but the greater number of these have some permanent paralysis of the nature described above.

As regards the pathology of this condition, we believe it to be a general disease of the whole body, a particular seat of election for the action of the virus being the central nervous system. In our view, it closely corresponds in its clinical symptoms and pathological anatomy with acute poliomyelitis in man.

To particularise now with regard to the pathological anatomy:

up to the present time in eleven cases, from four different parts of Scotland, exhibiting the symptoms described above and showing no gross lesion post-mortem, we have found the following microscopic changes in the central nervous system. In the acute stage of the disease (Plate III. Fig. 1) we have found the pia mater and the grey and white matter of the brain infiltrated with small round cells. The vessels of the brain and cord are engorged with blood and their perivascular sheaths are infiltrated with small round cells, cells with a clearer round nucleus and a larger amount of protoplasm, and cells with deeply indented nuclei which in some cases almost resemble polymorphonuclear nuclei. In the chronic stage (Plate III. Fig. 2), the pia mater, nerve roots, the grey and white matter, and the perivascular sheaths of the vessels are infiltrated with the small round cell and with cells probably derived from proliferation of connective-tissue cells. The nerve cells, especially of the anterior horns of the spinal cord (Plate III. Fig. 3), are in all stages of disintegration, from conditions of chromatolysis, pyknosis, excentricity of nuclei, to entire disappearance and replacement by neuronophages. We have made cultures on blood agar from the cerebro-spinal fluid of a number of acute and chronic cases alike, but have never succeeded in getting any growth.

In two of our most acute typical cases we injected pieces of the brain, emulsified in the cerebro-spinal fluid, intracerebrally, after trephining, into two other sheep without result.

The cerebro-spinal fluid in all the cases was water clear, and on microscopical examination showed very few cellular elements. The method we adopted for getting it in a large quantity, aseptically, at the post-mortem, was to cut down on the atlanto-axial ligament. After bending the sheep's chin on its neck, the ligament was scraped clean of muscle with a knife, care being taken not to cut it, sterilised with a paraffin blow lamp, and then pierced in a direction towards the brain with a curved sterile glass pipette. Large amounts of fluid could be obtained thus. As regards the other pathological conditions present in these cases, we generally found the other organs healthy except for the usual cloudy swelling, etc., in the acute cases. In one lamb we found an acute gastro-enteritis. None of these findings were obtained, however, often enough to justify us, at present, in giving them a place in the pathological picture. Enlarged lymphatic glands were found in all cases, but this is such a common finding in sheep dying of any cause that at present we do not attach any importance to it. Throughout our work we endeavoured to corroborate Hamilton's (1906¹) observations on the subject, but found nothing to support his views on the pathology of the condition. It may be stated that Römer (1911²) has recorded a paralytic condition, resembling human poliomyelitis, in the guinea-pig. He describes it as an infiltrating meningo-myelo-encephalitis chiefly of the lymphocytic type. Accord-

FIG. 1.

FIG. 2.

FIG. 3.

ing to Römer it is due to a filtrable, ultramicroscopic, glycerin-resisting virus of a similar nature to that found in human poliomyelitis. Flexner and Clark (1913³) have also described in a dog a case of paralysis, resembling human poliomyelitis clinically and pathologically, except that few neuronophages were seen and the disease was not transferred to other dogs by inoculation. It will be seen that in the disease we have been studying neuronophagia is marked (Plate III. Fig. 3), but we have not been able to transmit the disease by inoculation.

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DESCRIPTION OF PLATE III.

- FIG. 1.—Section of brain of lamb in the acute stage of the disease, showing congested blood vessels, infiltration of the perivascular spaces of the blood vessels and of the brain substance with the cells described in the text. ($\times 60$.)
- FIG. 2.—Section of the anterior horn in the lumbar enlargement of the cord of a lamb with the chronic disease, showing infiltration of the blood vessels and of the grey matter with cells, and disappearance of the nerve cells. ($\times 60$.)
- FIG. 3.—Section from the lumbar enlargement of the cord in a sheep with the chronic condition, showing one nerve cell entirely replaced by neuronophages and two cells undergoing phagocytosis. ($\times 300$.)