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# The Bacteriology of Lamb Mortality

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THE percentage of lamb losses as lambs born dead and dying within the first week of life have been reported in New Zealand by Barton (1947), Wallace (1949), Goot (1951), and Clark et al (1953). These authors give losses for both stud and commercial flocks ranging from 7.8 to 15.6% of lambs born.

Detailed examination into the causes of this mortality have been carried out in this country by Wallace (1949) and McFarlane (1954) and in Australia by Moule (1954). McFarlane did not carry out any cultural examinations, but he mentioned that 10% of the neonatal mortality was due to navel infection. Moule in his survey examined 453 lambs born dead or dying within three days and from only eight, were pathogenic bacteria cultured.

Workers at Wallaceville have in recent years demonstrated a number of infective agents responsible for outbreaks of abortion and/or neonatal mortality. The first part of this paper briefly describes these infections and the second part details a limited survey conducted to ascertain the importance of infection as a cause of lamb mortality.

## CHECK LIST OF INFECTIONS ENCOUNTERED IN NEW ZEALAND.

The list below includes organisms that can be responsible for intrauterine deaths, stillbirths or death of lambs within seven days of birth:—

TABLE I.

1. *Listerella monocytogenes*.
2. *Vibrio foetus*.
3. Type I abortion (*Brucella* mutant).
4. Type II abortion (?*Toxoplasma*).
5. Type III abortion (gram positive aerobic sporing bacillus).
6. Unidentified streptococci.
7. *Pasteurella haemolytica* and others.
8. *Clostridium septicum*.
9. *Clostridium oedematiens*.
10. *Clostridium chauvoei*.
11. *Clostridium welchii* Type D.

With the exception of *Cl. septicum*, causing malignant oedema, *Cl. chauvoei* causing blackleg and *Cl. welchii* Type D causing enterotoxaemia, all the other organisms have been recognized as a cause of neonatal mortality since 1950. The list does not include *Fusiformis necrophorus*, *Staphylococcus aureus*, or *Corynebacterium pyogenes*; these organisms, although most probably gaining entrance to the lamb through the navel at or shortly after birth, do not cause death for at least a week thereafter.

Infection with the first four organisms mentioned in the above table usually causes premature delivery of dead or weak lambs. Those infected with *Vibrio* and *Listerella* usually show signs of intrauterine decomposition, whereas those born dead from foetal membranes affected with Type I and Type II abortion are usually quite fresh when born. However, in the case of twin births, in any of these infections, one foetus and membranes may show signs of considerable intrauterine decomposition and the other be quite fresh. Further, lambs may be born alive at full term and survive from membranes affected with Types I and II abortion and odd lambs may be born alive at full term with vibrio infection but succumb in the first 24 hours.

Streptococcal and Pasteurella infections were recognized for the first time in 1954. As these organisms have been cultured from several stillborn lambs infection presumably can be intrauterine. However, in those lambs dying 1-3 days after birth it is not yet possible to state the source of infection or the route of entry.

In the cases of *Cl. septicum*, *Cl. oedematiens* and *Cl. chauvoei* infection, the organisms almost certainly enter the navel at or shortly after birth.

#### **Vibrio foetus infection.**

This condition was first recognized in New Zealand in 1950 by McFarlane et al (1952) and since then has been diagnosed on approximately twenty properties. The foetal membranes do not show any characteristic lesions but the foetus sometimes shows characteristic circumscribed areas of necrosis in the liver. We do not yet know whether the ram plays any part in the dissemination of this infection.

#### **N.Z. Type I abortion (*Brucella mutant*)**

Field infection of ewes with this organism has been reported in New Zealand by McFarlane et al (1952) and experimental infection by Hartley et al (1954a). The organism concerned is also responsible for the majority of cases of epididymitis in rams and has been shown by Buddle and Boyes (1953) to belong to the *Brucella* group. Infected foetal membranes invariably show extensive necrosis and oedema, being similar in appearance to bovine membranes infected with *Brucella abortus*; no obvious lesions have so far been encountered in lambs born dead from infected membranes. Ewes are presumed to become infected at tupping through service by rams excreting the *Brucella* organism in their semen. Infection has been diagnosed at Wallaceville in the foetal membranes received from approximately 45 properties.

#### **N.Z. Type II abortion**

This condition of the foetal membranes has been reported only from New Zealand (Hartley et al, 1945b) and has been diagnosed on approximately 60 properties. Here the lesions are seen as multiple small white necrotic foci confined to the foetal cotyledons. We do not know whether these lesions are caused by the *Toxoplasma*-like bodies constantly seen in histological sections, or whether they are the result of an unrecognized infectious or nutritional agent.

*Listerella* and N.Z. Type III abortion appear to be of minor significance having been encountered only on one property each. *Salmonella abortus ovis* and the virus of Enzootic abortion (Stamp et al, 1950) have not been encountered so far in New Zealand).

#### **Streptococcal infection**

Streptococci were the only organisms cultured or seen in tissue sections from two sets of foetal membranes showing obvious lesions. In addition Streptococci were isolated from a lamb showing signs of intrauterine decomposition, from cases of dystokia, from stillborn lambs several of which showed focal necrotic lesions in the liver and/or a fibrinous or gelatinous pericarditis and also from lambs dying from 1-7 days.

As the majority of Streptococci could not be identified it would be imprudent at this stage to state that all the Streptococci isolated were responsible for the deaths of the lambs from which they were cultured.

#### **Pasteurella infection**

Pasteurella organisms were isolated last lambing season from about twenty lambs. A few of the cases were from stillbirths and dystokias but the majority occurred in lambs dying 1-3 days after birth. In the latter group the commonest post-mortem finding was a mild to severe serofibrinous peritonitis with oedema and congestion

of the peritoneal fold about the umbilical arteries and bladder. Other cases showed multiple small foci of liver necrosis and a few showed bronchopneumonia and fibrinous pleurisy. Another common finding was grossly enlarged and dark congested mesenteric lymph nodes.

Almost all the *Pasteurella* isolated could be classified as *Pasteurella haemolytica* on biochemical reactions; of the remainder at least one was *Pasteurella pseudotuberculosis* and one was probably *Pasteurella multocida*.

**Clostridial infection:**

**Cl. septicum**

This is probably the commonest anaerobic organism responsible for navel infection. Affected lambs die within 2-5 days of birth and on post-mortem show extensive oedema and congestion of the subcutaneous tissues about the navel, oedema and congestion of the peritoneal fold enveloping the umbilical arteries and bladder and also usually an extensive serofibrinous peritonitis.

**Cl. oedematiens.**

This newly-recognized infection was seen in three lambs dying 1-3 days after birth. There was little or no subcutaneous oedema about the navel but there was extensive oedema and congestion of the peritoneal fold about the bladder together with thickened umbilical arteries. These structures showed focal serosal ulceration to which loops of small intestine were loosely adherent.

**Cl. welchii**

Losses from enterotoxaemia caused by the toxin of *Cl. welchii* Type D occasionally occurred in lambs 2-7 days old. Most lambs showed the typical post-mortem appearance but one showed only clear fluid and fibrin clot in the pericardial sac together with distinct symmetrical haemorrhages in the brain stem.

Neonatal mortality from *Cl. chauvoei*, has not been recognised by the authors, but records of the diagnostic section show that it does occur. Lamb dysentery has not been encountered so far, in New Zealand.

**LAMB MORTALITY SURVEY.**

During the 1954 lambing season we received 288 dead lambs from the Department of Agriculture farms at Manutuke, Ruakura, Whatawhata and Wallaceville; this number accounted for approximately 90% of the lambs born dead or dying in the first week of life. In addition foetal membranes were forwarded when they could be identified with the dead lambs.

These lambs were forwarded to Wallaceville by the quickest route available; those from Manutuke being sent by airfreight. The lambs arrived in a good state of preservation and in most cases bacteriological examinations were carried out within 48 hours of death.

**Pathological Data**

From a general morbid anatomical examination the 288 lambs were divided into four groups:

**TABLE II.**

1. Lambs dying in utero .....	11 or 3.8%
2. Lambs dying during the birth process .....	130 or 45.1%
3. Lambs dying shortly after birth .....	51 or 17.7%
4. Lambs dying one to seven days after birth .....	96 or 33.3%

A combination of morbid anatomical and bacteriological observations showed a fairly satisfactory cause for the death of 216 or 75% of the lambs received. These findings are analysed in Table III.

TABLE III.

Cause	No. of lambs	% of lambs examined	% of lambs born
Dystokia .....	86	29.9	3.4
Dystokia plus infection ....	10	3.5	0.4
Infection .....	48	16.7	1.9
? Infection .....	6	2.1	0.25
Starvation .....	44	15.3	1.75
Exposure .....	11	3.8	0.4
Congenital abnormalities	7	2.4	0.3
Predators .....	4	1.4	0.15
No significant findings ....	72	25.0	2.8

From these data it will be seen that 96 or 33.3% of lambs examined showed definite evidence of dystokia and 64 or 22.2% showed evidence of infection. It will also be seen that for every 100 lambs born 3.8% died associated with dystokia and 2.6% associated with infection.

The bacteriological findings for the 58 lambs from which potentially pathogenic organisms were isolated are analysed in Table IV.

TABLE IV.

Organism	Group (Table II)				Total	% of lambs received
	1	2	3	4		
<i>V. foetus</i> .....	1	2	1	4	4	1.4
Type I .....		5			5	1.75
Type II .....		1			1	0.35
Streptococci .....	1	9		5	15	5.2
Pasteurella .....		6	2	13	21	7.3
<i>Cl. septicum</i> .....				5	5	1.75
<i>Cl. oedematiens</i> .....				3	3	1.05
<i>Cl. Welchii</i> Type D				4	4	1.4
TOTAL .....	2	23	3	30	58	
% infection in each group .....	18.2	18	5.9	31.3		

The table shows that in this survey the highest incidence of infection occurred in Group 4, and that Pasteurella and Clostridia were chiefly responsible for these deaths.

### Lambing Data

Through the kind co-operation of the Research Officers on the Departmental farms concerned, we have been able to analyse certain lambing data from the five main ewe flocks.

Column I of Table V expresses the ratio of ewes experiencing neonatal mortality to the number of ewes put to the ram. Column II expresses the ratio of ewes experiencing neonatal mortality to the number of ewes lambing. Column III expresses the ratio of lambs born dead or dying within 7 days to the total number of lambs born.

**Flock A** was run on the Gisborne flats and consisted of 344 5-year-old and older sheep. The number of ewes not lambing was 14.88% and the lambing percentage at one week was 109. (Included in the figure for lamb losses is a set of sextuplets and several lambs from sets of quadruplets.

**Flock B** was run on dairy country at Ruakura and consisted of 307 5-year-old ewes; 11.4% of the ewes put to the ram did not lamb and the lambing percentage was 106.

**Flock C** was also run at Ruakura and was made up of 416 mixed age ewes (half being two- and four-tooth ewes); 16.8% of these ewes did not lamb and the lambing percentage was 79.

**Flock D** was run on the Ruakura hill station at Whatawhata and consisted of 400 mixed age ewes; 17.3% of these ewes did not lamb and the lambing percentage was 78 at one week.

**Flock E** was also run at Whatawhata and consisted of 326 mixed age cross-bred ewes; 21.5% of the ewes put to the ram did not lamb and the lambing percentage was 86.

In these five flocks 295 or 16.5% of the ewes put to the ram did not lamb. The overall lambing percentage was 91.0%; this being very close to the estimated average lambing percentage for the districts concerned.

**TABLE V.**

Flock	I		II		III	
	Ratio	%	Ratio	%	Ratio	%
A	36/344	10.5	36/293	12.3	50/426	11.8
B	24/307	7.8	24/272	8.8	26/353	7.4
C	64/416	10.5	64/346	18.5	67/395	17.0
D	33/400	8.3	33/331	10.0	34/352	9.7
E	22/326	6.7	22/256	8.6	24/305	7.9
TOTAL	179/1793	10.0	179/1498	11.9	201/1831	11.0

Table V shows (a) that 10% of ewes put to the ram had one or more dead lambs; (b) that 12% of all ewes lambing experienced neonatal mortality; and (c) that 11% of lambs born were dead at birth or died within the first week of life.

#### Loss to the Sheep Industry

From Table V, the sum of the number of ewes experiencing neonatal mortality together with those failing to lamb shows that approximately 25% of ewes put to the ram were not in full profit during the 1954 lambing season. If this figure can be taken as average for the Dominion there will be an annual loss to the sheep industry of approximately eight million lambs.

The full part that infection plays in this loss is not known. We do not know whether infectious diseases are concerned with the poor lambing percentages in two-tooths in particular or the empty ewe problem in general. We do know that infections play an important role in neonatal mortality, and if the figures for the above flocks can be taken as average for the Dominion it means that infections will cause an annual estimated loss of approximately 600,000 lambs.

#### SUMMARY

The first part of this paper outlines the infective conditions causing lamb mortality in New Zealand, including a brief description of newly recognised infections caused by *Cl. oedematiens*, *Pasteurella* and *Streptococci*.

The second part describes a survey into the causes of lamb mortality. In the five flocks analysed, the neonatal mortality ranged from 7.4 to 17 per cent. Approximately 20 per cent of this loss was attributed to infective agents.

#### Acknowledgments.

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## Joint Discussion

Mr. ANDREWS: What are your views on goitre as a factor in neonatal lamb mortality?

Mr. McFARLANE: It depends on the definition of goitre. A normal gland is 1-2 g. Some were 5-10 g. and some 800-1000 g.

Mr. JEBSON: On farms where pre-lambing shearing is carried out, lambing percentage is increased due to reduced losses from dystokia, exposure and starvation. Have you any data of such flocks.

Mr. McFARLANE: There is a wide variation in mortality both between properties and between years on the one property. Few farms are practising pre-lambing shearing.

Mr. ENSOR: Sandy soils of North Auckland are deficient in both Copper and Cobalt. Do these come into the picture?

Mr. HARTLEY: Swayback is rare in New Zealand. We looked at all the brains of lambs 3-5 days old and where history of nervous symptoms was given.

Mr. ANDREWS: There is no evidence of cobalt deficiency having any effect before November or December at the earliest.

Mr. SINCLAIR: At Kirwee the losses were 18% as two toothed and 9% in the same ewes 5 seasons later. The average was 14% expressed as lambs dying over lambs born.

Mr. McFARLANE: The method of expressing lambing percentage as lambs per ewes to lamb can only be done on research stations.

Mr. LAMBOURNE: Why cannot one use docking tallies plus dead lambs?

Mr. McFARLANE: On some farms many of the dead lambs are not seen. As far as control is concerned vaccination is not very promising because of the wide variety of causative organisms so we may have to rely on management or chemotherapy.

Mr. WILLIAMS: Are the farmers who record their losses better than average?

Mr. CLARK: At Ashley Dene 15% of all lambs dropped died within 7 days. Of the dead lambs 12% were lost in one storm, 7% from goitre, 3% were slipped and 5% were abandoned. Assistance given at lambing time will help and use of infra-red incubator is of some use, the lambs being released 1-4 hours later.

Dr. EDGAR: There is less trouble from dystokia if the ewes are not too fat. More ewes in Poverty Bay are on the hills.

Mr. McFARLANE: Some dystokias were intrauterine infection, with small lambs, and uterine inertia. Infected lambs are dopey and can be saved by feeding or penicillin possibly.

Mr. LAING: Of the navel infection how many of the organisms were shown to kill experimentally.

Mr. HARTLEY: **Pasteurella.**  
**Cl. septicum.**  
**Cl. oedematiens.**