

ORIGINAL ARTICLES —

INFESTATION OF SHEEP WITH THE FACE LOUSE (*LINOGNATHUS OVILLUS*).

By M. D. MURRAY, B.Sc.(Vet.Sc.), M.R.C.V.S.,

Division of Animal Health and Production, C.S.I.R.O., McMaster Laboratory, Sydney.

Introduction.

Linognathus ovillus was first discovered by Gilruth (1906) in New Zealand and by Evans (1907) in Scotland. Specimens from both these sources were sent for identification to Neumann who (Neumann 1907) subsequently described the louse and named it *Haematopinus ovillus*. However, during revision of the classification of the Anoplura it was recognised that this louse was a member of the genus *Linognathus* and, at present, its specific name according to Ferris (1932, 1951) is *Linognathus ovillus* (Neumann).

Since these first records of *L. ovillus* there have been authentic reports of its occurrence in New South Wales (Johnston and Harvey 1913, Ferris 1932) and the Falkland Islands (Ferris 1932). It has also been reported in the United States, Russia and Algeria but Ferris considers these reports as dubious. In Australia, according to Seddon (1951), it has been reported from New South Wales, Queensland, South Australia, and the northern part of Tasmania. However, as Roberts (1953) has pointed out, many of the Australian records are doubtful as some observers have obviously confused *L. ovillus* with *L. pedalis*, the foot louse of sheep.

In October, 1951 a flock of sheep in Victoria was found to be infested with *L. ovillus*. As little was known of the biology of this louse, the flock was kept under observation from September, 1952, until July, 1953. This paper presents the results of some of the investigations carried out during that period.

The infested sheep were Lincoln-Merino cross-breeds which had been bred on the property. Until 1951 louse infestations had not been seen amongst them: the only sheep which had been introduced were Lincoln rams in 1947 and 1949. Unfortunately, it was impossible to examine these animals as they had been disposed of, and Merino rams, bred on the property, were then being used.

The sheep were examined for infestations with *L. ovillus* just before shearing in September, 1952, at dipping in October, 1952, at crutching in February, 1953, and a week after lamb-marking in July, 1953.

The Seasonal Variation in the Size of the Population and Its Distribution on the Body.

For two years the grazier had failed to notice any lice until the sheep were shorn in September, when he saw them in large numbers on the face and head. It appeared, therefore, that populations of *L. ovillus* increased during the winter months and had a definite distribution on the body.

Early in September, 1952, a careful examination was made of some infested sheep by examining the head, legs and feet in detail and the body at three-inch intervals along its length and down the sides. The results of the examination of 12 animals are shown in Table 1.

The greatest numbers of lice were found on the face, head and the ventral parts of the neck.

Table 1.
Distribution of *L. ovillus* on some infested sheep at the end of winter, 1952.

	Face	Head	Neck	Back	Shoulders	Belly	Legs	Feet
Ewes								
1	†	*	*	*	*	—	*	*
2	*	*	*	*	*	—	—	—
3	*	*	*	*	—	—	—	—
4	†	†	†	†	*	—	—	—
5	—	*	*	*	*	—	—	—
6	*	†	†	*	*	—	—	—
7	*	*	*	—	—	—	—	—
8	†	*	—	*	—	—	—	—
9	*	*	*	*	*	—	—	—
10	*	†	*	*	*	*	—	—
11	†	†	†	—	—	—	—	—
12	‡	‡	‡	†	*	*	—	—

‡ Very heavy infestation
† Heavy infestation
* Light infestation.

In very he
eggs and l
with the
colour to



The pop
lice spread
ventral as
tribution o

Some o
identified
tember an
just before
moved ma
numbers o
result tha
only on th
were taken
not shorn
they, too,
population
constant o
no time w
hairy part
diately sur

All the
dipped in
group was
animals we
ful examin
and in th
At this ti
obvious in
the proper
but when

In very heavily infested animals, the number of eggs and lice was so great as to impart, together with the excreta of the lice, a reddish-brown colour to the fleece (see Figure 1).



Figure 1

The population consisted of a dense mass of lice spreading from the facial region down the ventral aspect of the neck with a scattered distribution of lice over the rest of the body.

Some of the heavily infested animals were identified before they were shorn in late September and were re-examined five weeks later, just before they were dipped. Shearing removed many of the lice but a further decline in numbers occurred during this period with the result that living lice could be found readily only on the face and head. Two sheep, which were taken to the McMaster Laboratory, were not shorn but during the same period of time they, too, showed a similar decline in the louse population. These two animals were under constant observation until April, 1953, and at no time were lice found anywhere but on the hairy parts of the face and in the wool immediately surrounding these regions.

All the sheep on the affected property were dipped in October. When an experimental group was examined in February, 1953, some animals were found to be still infested but careful examination revealed lice only on the face and in the wool immediately surrounding it. At this time the grazier had not noticed any obvious infestations among the other sheep on the property nor did he see any in April, 1953, but when he mustered them again in July he

noticed many obvious cases. A week later, our next examination of the flock was made and 40 infested sheep were examined in detail.

Lice were very numerous on the face of one, numerous on two, readily seen on 22, readily found by search on 9 and only a few were found on 6. On the sheep which was very heavily infested, lice were readily found on the body and were particularly numerous on the ventral aspect of the neck. On the two sheep with heavy infestations the lice were numerous on the ventral aspect of the neck and fairly numerous over the body. On 32 of the others, lice were readily found on the body and on the remaining 5 no lice were found on the body.

It was obvious that the number of lice on and around the face was increasing and they were starting to spread down the ventral aspect of the neck. A few lice were found scattered over the upper part of the body in all but five of the 40 sheep examined.

Observations on the Life Cycle and Behaviour of *L. ovillus*.

Linognathus ovillus completed its life cycle on the host in about 5 weeks, the stages being the egg, three nymphal instars and the adult females and males.

The eggs, which were dark in colour, were laid singly and those on the hairs of the face were attached about 0.1 inch from the skin. The distance from the skin of eggs deposited in the wool surrounding the face varied considerably. On the hair of the face only one egg was laid on each fibre but in the wool-covered regions many eggs were found attached to a single fibre, especially when the population was dense. In these circumstances eggs were present on wool fibres from near the skin almost to the tip of fibres up to some 2 inches in length. After laying each egg, the female usually changed her position only about $\frac{1}{8}$ of an inch so that females were frequently seen surrounded by a cluster of eggs. However, the females did not as a rule lay all their eggs in one vicinity and, although one female was observed to remain within an area of 0.25 sq. in. for 17 days, it was more usual for them to change their egg-laying site every few days. The females laid about one egg a day.

Eggs which were less than 48 hours old were removed, by plucking out the hair, and were exposed to a range of temperatures at a relative humidity of 40 per cent. or 60 per cent. As it was only possible to incubate a few eggs each day, some from each collection were incubated at 37.5°C. to act as a control. The results may be seen in Table 2.

When the sheep were examined in July, 1953, a distinct difference was noted in the habits of the lice on the various parts of the body, especially when a population was increasing rapidly. At this time the habitat could be divided into three re-

gions, the hairy areas of the face, the wool-covered areas surrounding the face on which the wool was only about 1 to 1½ inches long as a result of being clipped in April, and the rest of the body, excluding the shanks and feet, which was covered with a fleece several inches long. It was in the short-wooled areas surrounding the face, especially about the cheeks and nose, that the populations began to increase and in these areas some lice were usually seen on the wool tip. This habit of wandering to the fleece tip played an important part in the transmission of the lice from the facial region to the body and from one animal to another. While the sheep were yarded it was noticed that lice on the fleece tip of the cheeks and nose were readily transferred to any object with which they came in contact.

In summary it may be said that the main features of the infestation of this flock of sheep with *Linognathus ovillus* were the increase of the louse population in the winter months, the characteristic distribution and the manner in which the population spread. A graphical representation of these features may be seen in Figures 2, 3 and 4.

The population initially increased in numbers in the wool surrounding the face and from there it spread in two ways; first gradually down the ventral aspect of the neck, increasing in density in the process, and secondly by being brushed off on to the body. This resulted in a very dense population on a small area including the facial region and extending down the neck and a much sparser population scattered over the rest of the body.

Control.

Because it is uncommon, *Linognathus ovillus* is generally stated to be of no economic importance. This, as with other louse infestations, is true if the problem is viewed from its importance to the wool industry as a whole but it is definitely not true from the individual grazier's point of view. In this instance, the price offered for the affected wool was low because, although scouring would remove the discolouration of the fleece, the bodies of many of the lice would remain in the wool during the processing and thus affect its industrial value. Secondly, shearers objected strongly to these lice crawling

Table 2.

The influence of temperature on the development of eggs of *L. ovillus*.

Temp. °C.	Relative Humidity %	No. of Eggs.	No. Hatched.	Time taken to Hatch.
40	60	31	0	—
37.5	40	44	42	} 11-13 days
	60	17	16	
32	40	5	5	} 13-16
	60*	12	12	
27	60	26	0	—

* Of two batches of eggs, 6 eggs in all, 4 failed to hatch but as there were no controls these results have not been included in the Table.

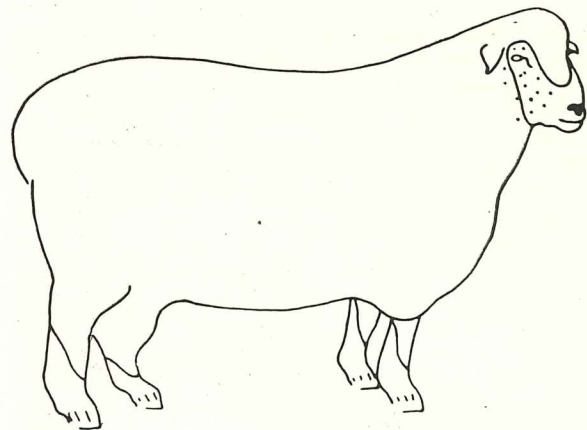


FIG. 2.

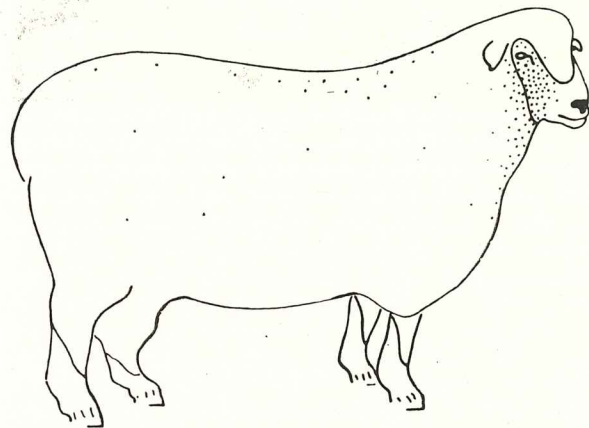


FIG. 3.

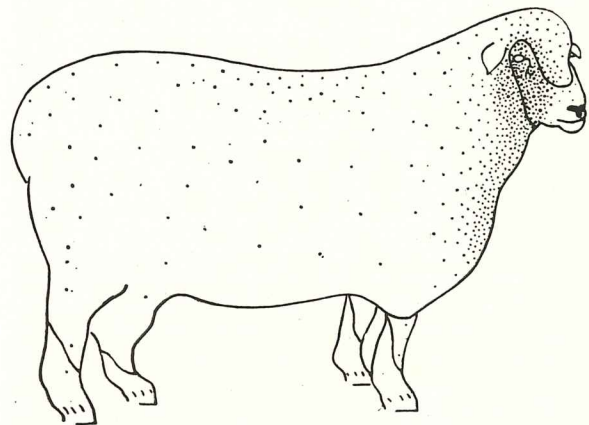


FIG. 4.

over their
that the li
were heav

As there
on the cor
of the floo
successful
benzene h
be effectiv
sonal comm
was to det
benzene h
isomer) re
linia ovis
L. ovillus
suitable di

Experiment

The hea
selected fr
divided in
dipped by
approxima
gamma B
nique was
was kept i
was immer
a swim di
centration
dipped the
level and
chloride w
ance for ‘

After th
remainder
in his usu
tant. Th
grazier ke
fluid at ab
no sheep w
ter of a mi
of the she
only imme
sheep spen
ability to
(15 feet)
them back.

After d
author wen
flock for e
were comp
sheep on t

Results.

The shee
first after
had elapse

over their bodies. There was no indication that the lice worried the sheep even when they were heavily infested.

As there was no information in the literature on the control of this parasite and the owner of the flock had used a derris-arsenic dip unsuccessfully, a dipping trial was conducted with benzene hexachloride, which has been shown to be effective against *L. pedalis* (Scott 1950, personal communication). The object of the trial was to determine whether the concentration of benzene hexachloride (0.005 per cent. gamma isomer) recommended for the control of *Dama-linia ovis* and *Melophagus ovinus* would control *L. ovillus* and at the same time to evolve a suitable dipping technique.

Experimental.

The heavily infested sheep, 92 in all, were selected from a flock of 450 sheep. These were divided into two groups of 46 animals and were dipped by the author in concentrations of approximately 0.005 per cent. and 0.01 per cent. gamma BHC respectively. The dipping technique was the same for each group; each animal was kept in the dip for one minute and its head was immersed six times. The dip, which was a swim dip, was first filled with the lower concentration and after the first group had been dipped the fluid was brought back to its original level and the concentration of benzene hexachloride was doubled, after making due allowance for "stripping."

After the second group had been dipped, the remainder of the flock was dipped by the grazier in his usual manner, the author acting as assistant. Throughout the whole operation the grazier kept the concentration of the dipping fluid at about 0.008 per cent. gamma BHC but no sheep was in the dip for longer than a quarter of a minute and, although the heads of most of the sheep were immersed twice, many were only immersed once. The length of time the sheep spent in the dip was determined by their ability to jump and swim the length of the dip (15 feet) as there was no baffle board to hold them back.

After dipping, the 92 sheep dipped by the author were isolated from the remainder of the flock for eight months and both mobs of sheep were completely isolated from all the other sheep on the property for the same period.

Results.

The sheep were subsequently examined twice, first after 2½ months and then after 8 months had elapsed. In the final examination all the

sheep dipped by the author were examined carefully and not one sheep was found to be infested. Of the 230 sheep dipped by the grazier 6 infestations, 4 of which were heavy, were found after a rapid and somewhat cursory search. In all probability many other animals were infested. On the same occasion a high percentage of infestations were found in a flock of sheep which the grazier had dipped before these trials were commenced.

It was concluded that, provided an efficient dipping technique is used, a complete control of *Linognathus ovis* could be obtained with benzene hexachloride when used at the concentrations recommended for the control of *Dama-linia ovis* and *Melophagus ovinus*.

Discussion.

It has long been appreciated that populations of lice fluctuate in size and are restricted in their distribution on the body of the host especially when at a minimum level. The site of this localised distribution is frequently the characteristic feature of the association between a louse and its host. *Linognathus ovis* is therefore no exception and these observations confirm the statements made by Gilruth (1906, 1907) and Evans (1907) that the louse is found in greatest numbers on the faces and cheeks of sheep in the spring.

The manner in which the population spreads is of great interest because it appears to be a characteristic of *Linognathid* infestations of sheep. The populations of both *L. ovillus* and *L. pedalis* show similar features when increasing, in that there is a very densely populated area of relatively small dimensions extending from the predilection site. This is not seen with infestations of goats with *L. stenopsis* or cattle with *L. vituli*. The manner of spread on the sheep must in some way be related to the existence of two distinct and sharply separated integumental coverings, the hair of the face and feet and the fleece which covers the rest of the body. On goats and cattle these differences do not exist so, apparently, the lice are able to spread over the body more readily.

A knowledge of the way in which populations of *L. ovillus* fluctuate is important when control measures are to be devised, especially when it is realised that the predilection site is on the head, a part of the body which is rarely dipped efficiently and frequently missed. The dipping trial showed that even when a grazier is conscientious in keeping the concentration of the dip correct, and on this occasion it was 1½

times the recommended concentration, a faulty dipping technique may render all his care valueless. Indeed, on the property on which this trial was carried out severe infestations developed on a high percentage of the sheep in other mobs which were dipped by the owner before the trial commenced. It is probable, therefore, that many of the reports of dips failing in the field result from faulty technique.

Summary.

An infestation of sheep with *Linognathus ovillus* (Neumann) is described. The population increased during the winter months to reach a maximum in the spring and decreased rapidly to a minimum in the early summer. When the population was at a minimum, lice could be found only on the hair-covered areas of the face and the lower jaw, and in the wool immediately surrounding these areas. From these sites the infestations spread over the body in two ways. First, by spreading slowly down the ventral aspect of the neck, increasing greatly in density in the process, and secondly by being brushed off the face to the body.

Observations on the habits of the louse on the sheep are recorded.

A dipping trial showed that benzene hexachloride, when used at the concentration recommended for the control of *Melophagus ovinus* and *Damalina ovis*, approximately 0.005 per cent. gamma isomer, would control *L. ovil-*

lus provided an efficient dipping technique was employed.

Acknowledgments.

The interest and advice of Mr. D. A. Gill, Officer-in-Charge of the McMaster Animal Health Laboratory, and the co-operation of the grazier on whose property these investigations were carried out, are gratefully acknowledged. Thanks are also due to Mr. N. P. Graham, B.V.Sc., Messrs. William Cooper & Nephews (Australia) Pty. Ltd., for bringing this outbreak to our notice.

References.

- Evans, W. (1907).—*Ann. Scot. nat. Hist.* 64: 225-226.
- Ferris, G. F. (1932).—*Leland Stanf. Univ. Publ. Univ. Ser.* No. 41: 346.
- Ferris, G. F. (1951).—"The Sucking Lice." (The Pacific Coast Entomological Society: San Francisco).
- Gilruth, J. A. (1906).—*Rep. Dep. Agric. N.Z.* 1906: 309.
- Gilruth, J. A. (1907).—*Rep. Dep. Agric. N.Z.* 1907: 194.
- Johnston, T. H. and Harrison, L. (1913).—*Proc. roy. Soc. Qd.* 24: 107.
- Neumann, L. G. (1907).—*Rev. vét., Toulouse* 32: 520.
- Roberts, F. H. S. (1952).—"Insects affecting Livestock." (Angus and Robertson: Sydney).
- Seddon, H. R. (1951).—*Serv. Publ. Dep. Hlth. Aust. vet. Hyg.* No. 6, pt. 2: 141.

(Received for publication 24 June, 1954.)

