

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP IN THE BORDER AREA

D. B. BARROW, Senior State Veterinarian, Mossel Bay, Cape Province

INTRODUCTION

The Great Kei River forms the boundary between the Eastern Province and the Transkei. The area to the west of this river is traditionally known as "The Border".

This is a summer rainfall area, rain being recorded from September to May with very dry winters. Although the annual rainfall varies from 1,000 to 1,150 mm, it may be as low as 300 mm.

The vegetation, well suited to live-stock farming, consists mainly of grass-veld interspersed with bush and small shrubs. Internal parasites, however, are a major cause of economic loss in wool, mutton and beef production.

For this reason a seasonal incidence survey of the common internal parasites of sheep was carried out over a period of years. Preliminary observations were published (Meldal-Johnsen, 1961). These investigations based on differential egg counts, have been continued and critical slaughter trials included.

WORM EGG COUNTS

Experiment 1

Materials and Methods

These were similar to those described by Meldal-Johnsen (1961). Differential worm egg counts were done on the faecal specimens collected every two weeks from the flocks of ewes and lambs on the farms Fort Cox, Dohne and Peninsula.

The survey ran from November, 1959 and ceased at Dohne in February, 1961 and at Fort Cox and Peninsula in November, 1961. Lambs were sampled throughout the survey period until they were over two years old; they are referred to as yearlings to distinguish them from their dams.

At Dohne the flocks grazed continuously on veld except for short periods on artificial pastures. Elsewhere they grazed on natural pastures only.

At Dohne, due to heavy infestations and mortality, the ewes and yearlings were treated with therapeutic doses of phenothiazine on 21 December, 1960. No treatment was applied on the other farms.

Climatic data were recorded on all three farms during the survey period.

Results

The results are illustrated graphically in Fig. 1, 2 and 3.

Received on 20 July, 1964, for publication.—Editor

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP

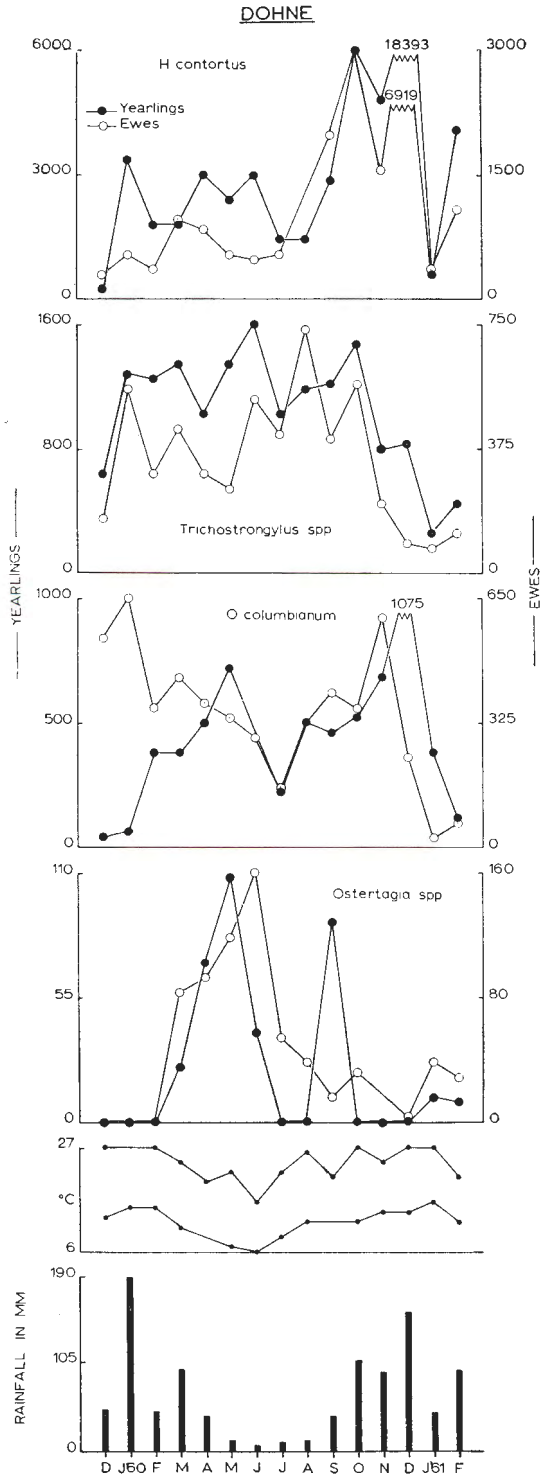


FIG. 1.—Experiment 1. Dohne. Mean egg counts in yearlings and ewes. Left ordinates = yearlings; right ordinates = ewes

— · — = Mean maximum and minimum temperatures.
 | — Monthly rainfall.

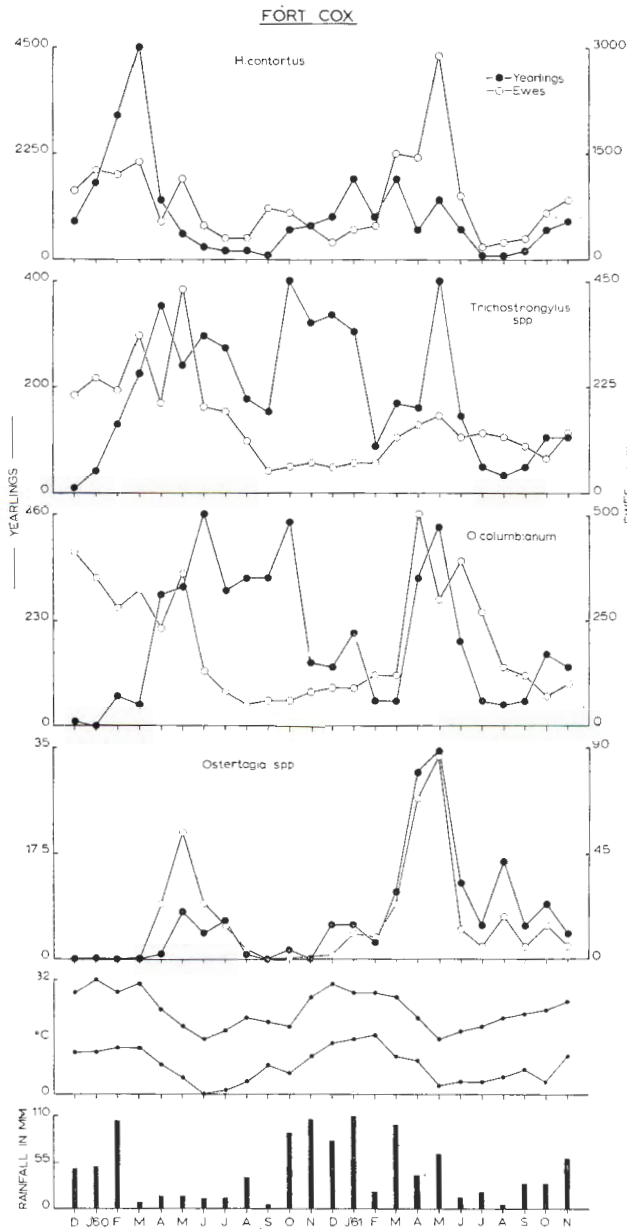


FIG. 2.—Experiment 1. Fort Cox. Mean egg counts in yearlings and ewes. Left ordinates = yearlings; right ordinates = ewes.

— = Mean maximum and minimum temperatures.
 - - - = Mean maximum and minimum temperatures.
 ■ = Monthly rainfall.

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP

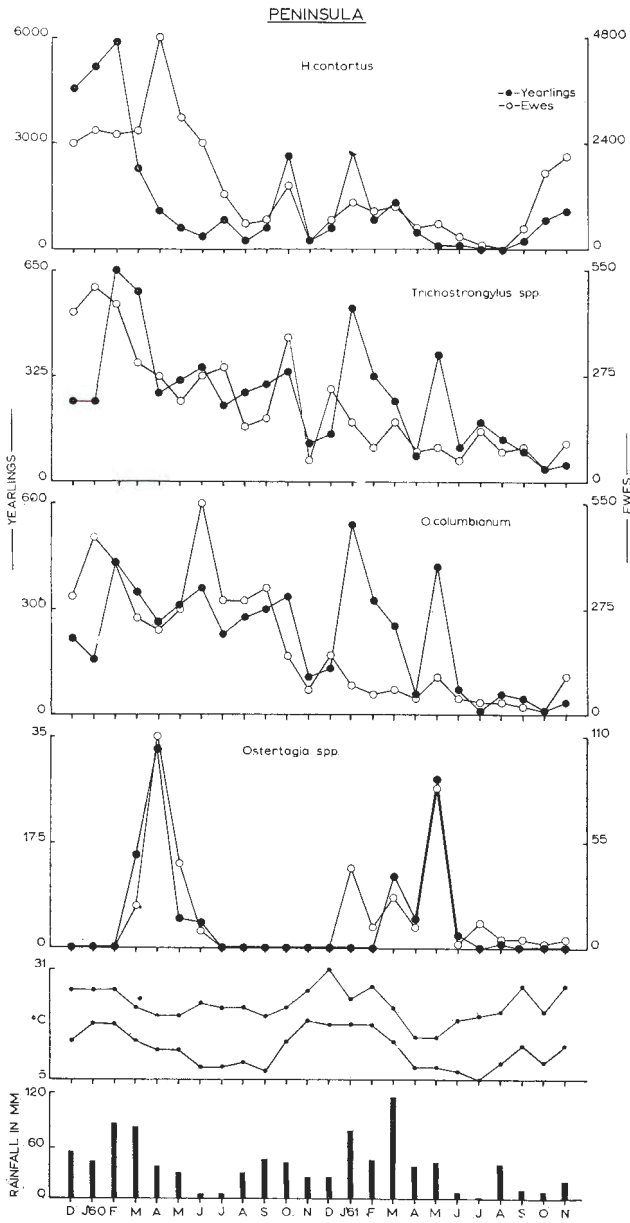


FIG. 3.—Experiment 1. Peninsula. Mean egg counts in yearlings and ewes. Left ordinates = yearlings; right ordinates = ewes.

— · — · — = Mean monthly maximum and minimum temperatures.
| = Monthly rainfall.

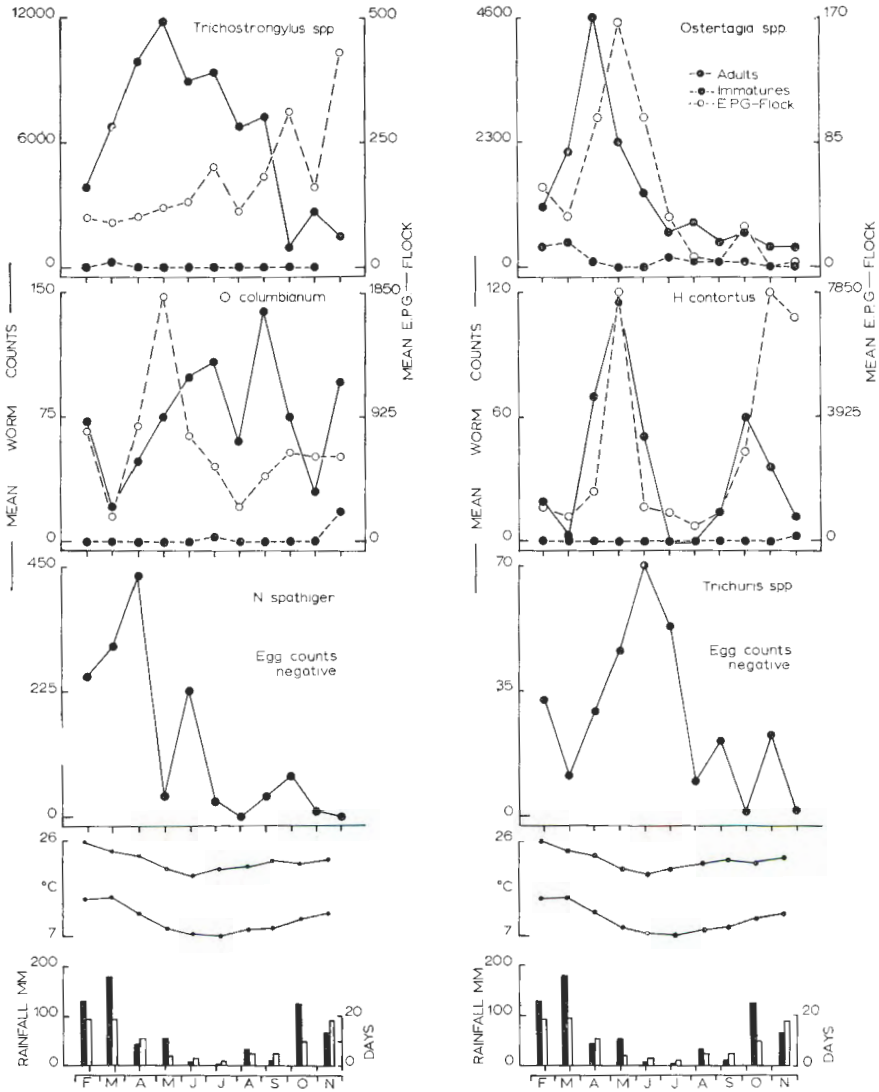


FIG. 4.—Comparison of worm counts in slaughtered sheep and egg counts of the flock at intervals of four weeks. Abscissa = four-weekly periods. Ordinates: left = worm counts; right = egg counts.

·—· = Mean monthly maximum and minimum temperatures.

█ = Monthly rainfall.

▨ = Number of days rain fell.

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP

Haemonchus contortus: In the ewes egg counts rose every autumn and again in October at Dohne. An explosive rise in December had to be controlled with phenothiazine. In the yearlings peak egg counts were recorded in January or February. After heavy rains at Dohne, yearlings died in December, 1960 with average egg counts of 32,553 eggs per gm (e.p.g.) before phenothiazine was administered.

Trichostrongylus spp.: As the egg counts fluctuated markedly it was difficult to assess seasonal trends. In the ewes they rose from February to April, apart from the flock at Dohne where peak egg counts were recorded in August. The interpretation of the data from yearlings was more difficult. In general egg counts rose any time from January to April to reach peaks either in the autumn, or as late as June. A secondary rise occurred in September or October.

Oesophagostomum columbianum: Egg counts in the flocks at Fort Cox and Peninsula rose in the autumn and early winter. Ewes showed this tendency every year whereas the yearlings exhibited it only after they were two years old. In the ewes at Dohne the egg counts fell from January until July; thereafter in both ewes and yearlings they rose to a peak before treatment in December.

Ostertagia spp.: This parasite was diagnosed for the first time in March, 1960. Egg counts rose rapidly, falling in June or July to either disappear or remain at low levels until March of the following year. A striking feature was that peak egg counts were invariably higher in the ewes than in the yearlings.

Bunostomum trigonocephalum: Eggs of this parasite were rare and only noted from January to March.

Nematodirus spp.: In their first summer young lambs at Dohne voided *Nematodirus* spp. eggs in their faeces. They were recorded in December, 1959, rose to a peak in January and disappeared after June, 1960. This genus was not diagnosed elsewhere.

Comment

The data obtained from egg counts were unsatisfactory and a more accurate assessment of worm burdens had to be made. This could be achieved by regularly slaughtering sheep, doing total and differential worm counts and comparing the actual worm burdens with data from egg counts.

An experiment of this nature was carried out at Dohne.

CRITICAL SLAUGHTER TRIALS

Experiment II

Materials and Methods

A flock of 85, 13-month old sheep, bred and reared at the Dohne Research Institute, grazed on the same pastures used in the previous experiment.

The flock was divided as follows:—

- (a) The survey group consisting of 25 sheep. Samples for faecal egg counts were collected from them every two weeks.
- (b) The slaughter group of 60 sheep. Two were killed fortnightly on the same day as the collection of samples from the survey group.

Post mortem examination. This was carried out according to the method described by Reinecke (1961).

This experiment ran from 6 February to 30 November, 1962 and was discontinued after the flocks were treated with phenothiazine in December.

Climatic data were recorded for the entire survey period.

Results

A. Faecal egg counts

Neither *Haemonchus contortus* nor *Oesophagostomum columbianum* showed peak egg counts that agreed with the data presented in the previous experiment. *Ostertagia* spp. were more consistent, larger numbers of eggs being recovered in the autumn and winter. *Trichostrongylus* spp. reached peak egg counts in November.

B. Worms recovered post mortem from the slaughter flock

The results are summarized in Table 1 and presented in order of prevalence.

Trichostrongylus spp.: This genus was dominant, rising steadily to a peak in May to fall gradually thereafter.

Trichostrongylus rugatus was the most prevalent species, followed by *T. colubri-formis* and *T. axei*: the highest individual counts were 15,405, 4,925 and 1,300 worms respectively.

The seasonal incidence of *T. rugatus* followed the pattern exhibited by the genus as a whole very closely. Peak worm counts of *T. colubri-formis* occurred in July, while *T. axei* reached large numbers in March, early April and November. Third stage larvae were recovered in fairly large numbers in the two sheep slaughtered on 14 November; at other times they were occasionally recovered in small numbers.

Ostertagia spp.: This genus was the dominant abomasal parasite. Worm counts rose sharply to a peak in April and early May, falling rapidly thereafter.

The most important was *O. circumcineta*, completely overshadowing *O. trifurcata*. Larval stages were present in most of the sheep slaughtered; the fourth stage being more numerous in the majority of autopsies. Larval counts were highest in March, four to six weeks before adult worm burdens reached their peak.

Oesophagostomum columbianum: Although present in moderate numbers varying from one to 280, this species was consistently recovered. It increased gradually through the winter to reach a peak in September. In three sheep only, a few fourth stage larvae were recovered.

Haemonchus contortus: This species occurred in 21 autopsies with a maximum of 322 worms in one sheep. Worm counts rose to a peak early in May to fall sharply later in the month and disappear from the end of June until early September. Larvae were rarely recovered, and in small numbers.

Nematodirus spp.: These species were absent in more than half the autopsies. Where present, the numbers varied between one and 1,044; in most cases moderate numbers were recovered. Worm counts rose to a peak on 3 April, thereafter fell sharply to appear erratically in small numbers.

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP

TABLE 1.—Worms recovered post mortem

Date	Sheep No.	TRICHOSTRONGYLUS					OSTERTAGIA				OESOPHAGOSTOMUM		HAEMONCHUS		NEMATODIRUS		TRICHOCHUS	
		3rd	4th	axei	rugatus	colubri-formis	3rd	4th	circumcincta	trifurcata	4th	columnbianum	4th	contortus	4th	spahiger		
6 February.....	1-95 1-32	0	0	0	1,607 3,170	357 820	0	0	0	1,416 143	358 27	0	20 200	0	30 0	0	210 80	60 20
20 February.....	1-68 1-201	0	0	0	4,199 1,391	495 3,029	0	1,605	0	826 1,584	17 44	0	30 40	0	0 44	0	700 0	10 40
6 March.....	1-42 1-101	0	399	240 205	3,480 5,596	1,140 808	0	1,938	0	1,008 1,548	48 68	0	13 40	0	12 0	0	192 735	13 0
20 March.....	1-226 1-71	2	47	357	12,876	213 1,700	0	25	0	5,073	477	0	27 30	0	0 0	0	296	13 30
3 April.....	1-267 1-123	0	60 48	430 68	11,045 12,961	2,520 2,282	60	240 96	0	3,189 5,154	129 205	0	40 80	0	43 68	0	544 1,044	40 80
17 April.....	1-5 1-79	0	0	124 165	6,680 1,298	1,416 239	0	40	0	3,900 4,740	440 550	0	40 26	0	0 165	0	80 51	0 0
1 May.....	1-278 1-32	0	0	236 138	12,099 9,537	2,638 1,937	0	0	0	3,241 3,634	276 92	0	16 45	0	0 322	0	147 0	16 45
15 May.....	1-213 1-295	10	10	396	6,799 9,876	1,123 1,920	10 40	60	0	28 1,554	38 34	0	120 120	0	0 18	0	0 0	40 80
29 May.....	1-27 1-296	10	12	38 251	365 15,405	100 3,172	16	28	0	1,137 680	24	0	250 100	0	2 102	0	0 0	0 250
12 June.....	1-204 No tag	0	0	350 374	2,158 10,634	1,162 1,691	0	0	0	938 2,516	112 136	0	87 47	0	0 102	0	0 907	46 27
26 June.....	1-207 1-189	6	25	234 132	8,458 6,640	2,843 3,560	96	192	0	684 145	36 31	7	80 280	0	0 0	0	106 0	60 120
10 July.....	1-13 1-66	0	0	308 1,098	8,771 3,225	2,615 437	8 300	120	34	530 1,157	40 23	0	20 56	0	0 0	0	0 0	14 18
24 July.....	1-1 1-92	0	0	120 486	0 11,054	10 2,160	72	40	477	5	115	0	46 72	0	0 0	0	0 0	0 21
7 August.....	1-10 1-21	3	10	378 322	4,408 4,148	1,454 2,068	30 35	63 76	860 1,010	10	10	3	57 56	0	0 0	0	0 0	8 10

TABLE 1 (contd.)

Date	Sheep No.	TRICHOSTRONGYLUS					OSTERTAGIA			OESOPHAGOSTOMUM		HAEMONCHUS		NEMATODIRUS		TRICHRUS
		3rd	4th	axei	raggatus	colubri-formis	3rd	4th	circum-cincta	trifurcata	4th	column-bianum	4th	contortus	4th	
21 August.....	6-13 1-45	0 5	24 0	330 14	13,505 4,542	4,925 1,554	60 19	36 7	669 225	91 5	0 0	110 89	0 0	0 0	0 0	36 21
4 September.....	7-60 1-6	0 0	5 0	1,300 1,280	792 92	198 368	40 0	45 49	264 450	36 50	0 0	213 137	10* 0	26 20	0 0	11 12
18 September.....	1-15 1-182	0 0	0 0	480 599	1,068 502	840 319	10 28	33 20	360 760	40 0	0 0	36 167	0 0	15 80	0 200	0 5
2 October.....	1-19 1-31	0 0	0 0	160 297	1,092 146	308 396	38 43	12 38	427 1,010	13 100	0 0	48 41	0 0	81 64	0 0	0 0
17 October.....	7-17 6-13	0 0	0 0	100 80	91 0	289 100	0 0	0 0	177 144	44 16	0 1	36 1	0 0	0 0	0 0	0 0
30 October.....	7-41 9-143	0 0	0 0	560 110	4,452 1,934	1,932 454	20 40	0 0	677 378	93 42	0 0	55 20	0 0	140 0	0 80	2 85
14 November.....	9-148 1-82	238 65	34 3	572 323	544 80	327 0	105 85	55 35	30 462	0 15	0 10*	99 128	0 0	10 0	0 70	4 0
30 November.....	5-684 8-76	0 30	0 0	540 220	1,148 0	892 190	0 60	0 40	330 485	0 10	0 0	102 42	0 10	20 10	100 0	2 0

3rd = Third stage larvae.

4th = Fourth stage larvae.

* = These were third stage larvae.

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP

Trichuris spp.: In all but eleven sheep slaughtered, moderate numbers were recovered, the highest count being 250. Counts rose steadily in the autumn, reached a peak at the end of May and fell to low levels in August.

C. Comparison of worm burdens with egg counts

To illustrate these trends, the average of four autopsies and the average egg count of the flock for that period are compared and illustrated graphically in Figure 4.

Trichostrongylus spp.: There was no correlation between the worm counts *post mortem* and the average egg counts of the flock. While the former rose sharply during the autumn and fell thereafter, the latter remained at a low level until the spring to reach a peak in November.

Ostertagia spp.: The two graphs showed the same trends but peak worm burdens preceded peak egg counts by some four to six weeks.

Oesophagostomum columbianum: Initially there seemed to be some correlation between the egg counts of the flock and the worm counts. From autumn to summer, however, there was no correlation.

Haemonchus contortus: This was the only species which showed a close correlation between worm burdens and egg counts. In October, however, egg counts rose while worm burdens fell.

Nematodirus spathiger and *Trichuris* spp.: As the egg counts were negative no comparisons could be made.

DISCUSSION

The seasonal incidence survey started by Meldal-Johnsen (1961) was continued along similar lines. It became increasingly obvious that the assessment of worm burdens based on egg count data alone, was so varied that it was impossible to interpret the results. All that could be added to Meldal-Johnsen's observations, was the fact that *Ostertagia* was recovered from faecal cultures in March, and its egg counts reached a peak in the autumn or winter. It was impossible to proceed along these lines and more critical methods of assay had to be applied.

The logical method was to slaughter sheep at regular intervals and carry out total and differential worm counts *post mortem*. These worm counts could be compared with data of egg counts on the flock under survey. In this way the validity of data obtained from egg counts would be subjected to a critical check.

It is unfortunate that the flock was treated in December which necessitated the premature termination of the experiment. The experiment should have covered the critical summer months from December to February, particularly in view of mortalities due to *H. contortus* in December, 1960 on the same farm. Regrettably, this period's seasonal incidence judged on a critical slaughter basis is lacking.

In spite of these defects, valuable information was gained from the critical slaughter experiment.

A most important observation was that *Trichostrongylus* was the dominant genus followed by *Ostertagia*. This was not suspected, as data from egg counts over-emphasized the importance of *H. contortus*.

Comparison of egg counts with worm burdens gave conflicting results. The only positive correlation was with *H. contortus*. A negative correlation was noted with *Trichostrongylus* spp. Egg counts of *Oesophagostomum columbianum* were a most unreliable indication of the worm burdens.

In *Ostertagia* spp. peak worm burdens preceded peak egg counts by four to six weeks, and the two graphs ran parallel during late summer and autumn but not during other periods. From mid-February to mid-March half the sheep slaughtered yielded large numbers of immature and mature worms. In April the number of mature worms reached a peak; immature worms were present in moderate numbers, decreasing in May. Egg counts fell in March and rose during April to reach a peak in May while immature worms were decreasing. Thus, where larger numbers of larvae were present, ovulation was depressed while the subsequent decrease of larvae had the opposite effect. These observations confirmed those of Michel (1963) who showed that in calves immature *Ostertagia ostertagi* depressed ovulation.

Gordon (1948) stated that *Trichostrongylus* spp. thrive in cooler conditions. This has been confirmed by the recovery of this genus in large numbers from March to August.

Some of the slaughter flock that died in the winter were not included in the experiment. Although total worm counts were not available, the cause of death was undoubtedly trichostrongylosis.

The significance of *O. columbianum* must not be under-estimated. As stated by Gordon (1950), 80 to 90 worms in a yearling and 200 to 300 worms in older sheep, represent a severe infestation. Individual sheep in February, May, June and September had more than 200 adult worms and the average burden in September was 140 worms. These worms, although few in number, must have had marked pathogenic effects, particularly as peak worm burdens followed severe *Trichostrongylus* infestations.

The grazing at Dohne in August and September has very little nutritive value and the winters are cold. During this experiment, temperatures from May to September varied from a monthly mean minimum of 7.2 to 8.7°C and a mean maximum of 13.4 to 15.3°C. The adverse nutritional and climatic conditions aggravated the effects of an already heavy *O. columbianum* worm burden.

Deaths are fairly common in this area in August and September, and one is loath to diagnose worms as the cause when only 100 to 200 *O. columbianum* can be demonstrated.

The treatment and control of internal parasites can best be carried out if Gordon's (1948) strategic and tactical drenching principles are followed. The following strategic doses are recommended for the Border Area:—

1. December—controls the rise of *H. contortus*.
2. March—controls *Trichostrongylus*, *Ostertagia* and *Nematodirus*.
3. June—controls *O. columbianum* and *Trichostrongylus*.

These strategic or routine drenches will prevent worm burdens from building up to dangerous levels. In December phenothiazine would suffice; in March and June the highly efficient anthelmintics, thiabendazole or methyridine, are preferable.

Tactical drenches can be administered at any time during the warmer months, within three weeks of well distributed rains in excess of 15 mm.

THE EPIZOOTIOLOGY OF NEMATODE PARASITES OF SHEEP

CONCLUSIONS

In seasonal incidence surveys, total and differential worm counts from sheep slaughtered at regular intervals are superior to the collection of data based on worm egg counts alone.

SUMMARY

Two experiments to determine the seasonal incidence of nematode parasites of sheep are described. These were based on differential egg counts and a comparison between critical slaughter trials and egg counts.

Trichostrongylus, the dominant parasite, reached peak worm egg counts in May, *Oesophagostomum* in September, *Ostertagia* in March, *Nematodirus* in April and *Trichuris* in June.

Haemonchus contortus reached peak egg counts in December, January or February and, in the critical slaughter trials, in May. Since there was close correlation between egg counts and worm burdens, the summer peak would probably have been noted if sheep had been killed during these months.

Except for *H. contortus*, egg count data could not be correlated with worm burdens in the slaughtered sheep.

Strategic dosing is recommended in December, March and June.

ACKNOWLEDGEMENTS

The author wishes to express his deep gratitude to Dr. R. K. Reinecke, Head of the Department of Parasitology, Onderstepoort for the manner in which he assisted throughout this survey. My thanks are also due to Mr. J. J. J. Kotze, Assistant Chief, Dohne Research Institute, Mr. H. H. Barnard and Mr. G. J. van D. Steyn of his staff for their assistance, and to Miss M. Collins for drawing the graphs. I appreciate the permission of the Chief, Veterinary Field Services to publish this paper. A special word of thanks to Mr. B. J. Schoeman who put in so many hours of hard work as my assistant.

REFERENCES

- GORDON, H. McL., 1948. The epidemiology of parasitic diseases with special reference to studies with nematode parasites of sheep. *Aust. Vet. J.* 24, 17-44.
- GORDON, H. McL., 1950. Some aspects of parasitic gastro-enteritis of sheep. *Aust. Vet. J.* 26, 14-28.
- MELDAL-JOHNSEN, C. M. T., 1961. Seasonal incidence of nematode parasites of sheep in the King Williams Town Area. *J.S. Afr. Vet. Med. Ass.* 32, 65-70.
- MICHEL, J. F., 1963. The phenomena of host resistance and the source of infection of *Ostertagia ostertagi* in calves. *Parasitology* 53, 63-84.
- REINECKE, R. K., 1961. Helminth Research in South Africa III. The diagnosis of nematode parasites in ruminants for worm survey purposes. *J.S. Afr. Vet. Med. Ass.* 32, 167-173.