Studies on the Spring Rise Phenomenon in Ovine Helminthiasis I. Spring Rise in Stabled Sheep*

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ABSTRACT

Serial ova count studies were conducted to determine some of the characteristics of the spring rise in faecal shedding of nematode ova by parasitized sheep in flocks in the Montreal area. It was discovered that substantial spring rises occurred in most ewes following their lambing but that great variation existed in the magnitude, duration, and pattern of the rises. Although rams did not display increased ova counts, a slight but well-defined rise developed in one unbred ewe.

Larval studies in ewes parasitized by a variety of nematode species, revealed that Haemonchus contortus **was the major contributor to the spring rise in faecal ova output.**

Preparturient treatment of ewes with thiabendazole[1], at the rate of 100 mg./kg. of body weight, suppressed spring rise but failed to arrest completely the faecal shedding of nematode ova.

Introduction

The spring rise phenomenon in sheep can be defined as a transient but marked increase in the faecal shedding of nematode ova by parasitized ewes in the springtime. First reported by Taylor (1) in England, it has since been observed by several authors in England and other countries. The subject has been extensively reviewed by Field *et al.* (2) and more recently by Brunsdon (3) and by Dunsmore (4).

The spring rise consists of a sudden increase in the rate of shedding of strongyle ova in the faeces of ewes in the springtime. According to Crofton (5), the rise reaches its peak in breeding ewes approximately six to eight weeks after parturition. Following this, the ova counts fall rapidly to low levels which are maintained throughout the remainder of the year. Crofton (6) and Field *et al.* (2) found the spring rise in barren ewes to be less common and of lower intensity than that in breeding stock. Crofton (6), furthermore, also described increased ova counts in autumn-lambing ewes. Thus, the usual association of this phenomenon with the springtime might be less important than its relationship to host reproduction and the rise, therefore, might more aptly be termed a "post-parturient" rise.

The exact cause of the increase in faecal ova output cannot clearly be defined. It is generally agreed, however, that the rise occurs subsequent to a depression of host immunity by stress factors such as gestation, parturition, and lactation and by winter climate and malnutrition (5, 7). As Soulsby (8) believes, however, the decline in host immunity may be due to a lack of antigenic stimulation associated with reduced larval intake during the winter stabling period.

Some controversy exists as to the origin of the strongyle ova whose sudden increase in number constitutes the spring rise. In this regard, Brunsdon (3) has summarized the three principal viewpoints as follows:

1. Spring rise may be caused by an increased fecundity of mature worms already present in the host.

[1]Thibenzole — 2-(4' thiazolyl) — benzimidazole (Thiabendazole) 57.85%. Water dispersible powder. Merck, Sharpe and Dohme of Canada Limited, Montreal, Que.

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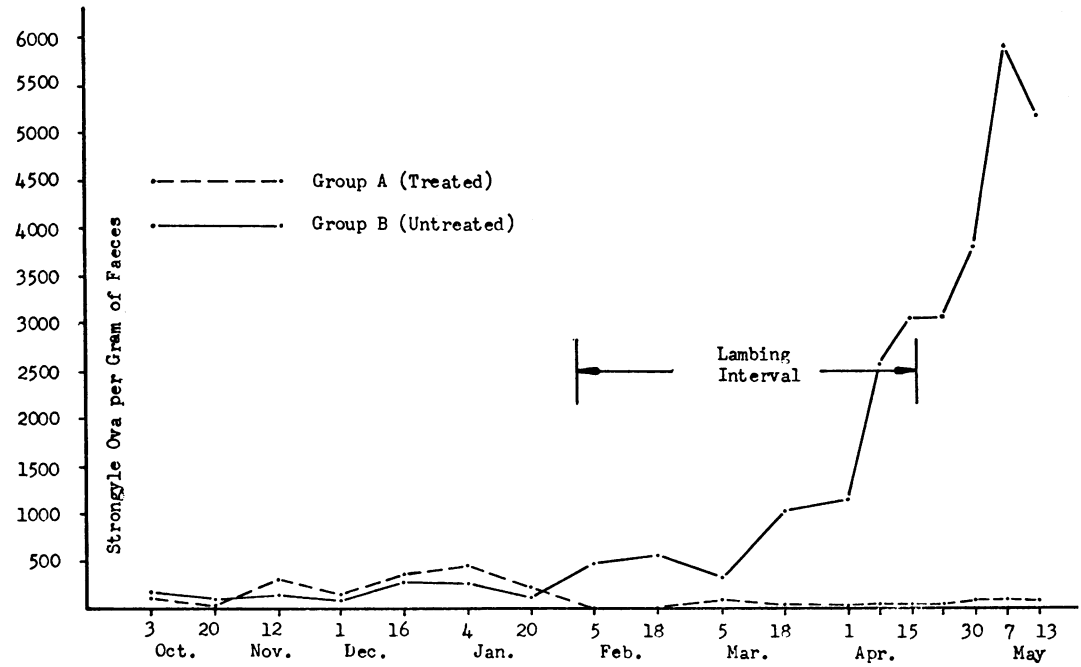
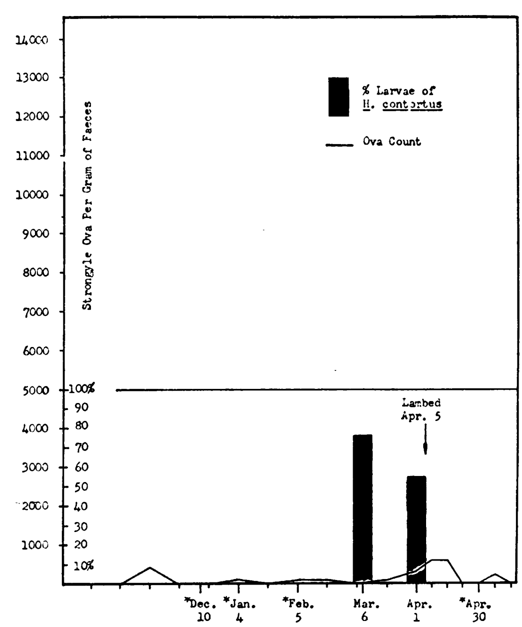


Fig. 1. Mean Strongyle Ova Counts of Untreated and Treated Ewes.

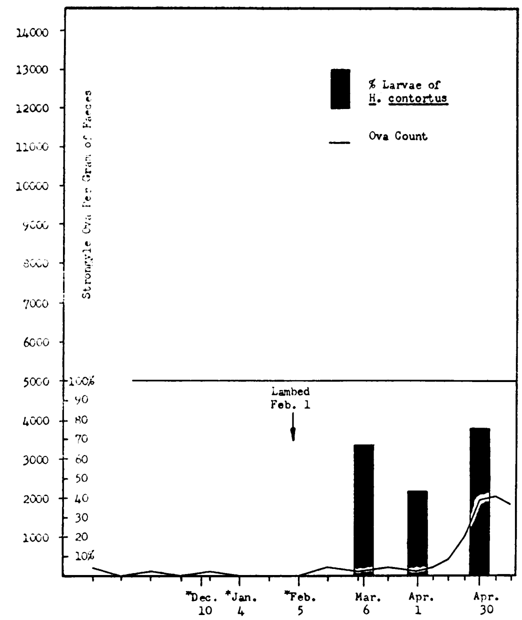
2. Spring rise may be the direct result of newly-acquired infection.
3. Spring rise may be the result of the maturing of dormant histotropic larvae which have overwintered in the mucosa of the abomasum or intestine.

The concept of "latency" of tissue stage larvae has not been adequately investigated and thus the presence of inhibited immature parasites prior to the time of spring rise has not been proven. Soulsby (10), however, by serial slaughter of ewes, demonstrated that almost all the parasite burden of adult sheep during the winter months consisted of inhibited larval stages. This and the majority of indirect evidence (2, 9) supports the view that the spring rise in faecal ova output is, in fact, due to the simultaneous maturation of latent overwintering larvae released from their tissue habitat by stress factors which depress host immunity.

Although it is assumed that spring rise is a universal phenomenon, there is no known published record of its occurrence in Canada. Gibbs (11), however, has described a winter outbreak of haemonchosis in stabled ewes which he attributed to the emergence of latent larvae and hence to the spring rise phenomenon. Subsequently, a 1964 ova count study by Gibbs (unpublished) confirmed the occurrence of spring rise in the sheep flocks of the Animal Pathology Laboratory and of the Macdonald College Farm.



***Low Larval Yield**
Fig. 2. Ova and Larval Count Values for Ewe No. 806.



*Low Larval Yield
Fig. 3. Ova and Larval Count Values for Ewe No. 812.

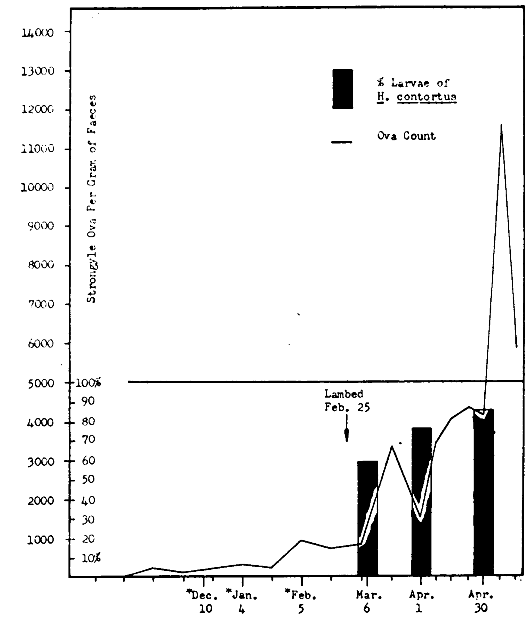


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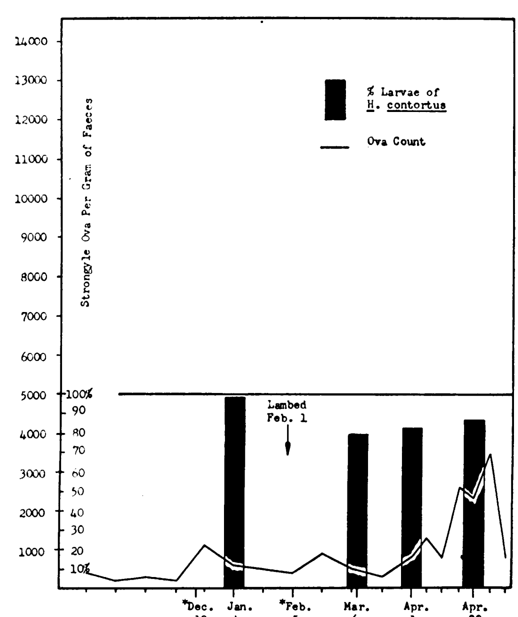
Fig. 4. Ova and Larval Count Values for Ewe No. 825.

Materials and Methods

The experimental animals employed in this study were 18 bred ewes of mixed ages and breeds (Suffolk, Southdown and Dorset Horn) that were part of the experimental sheep flock of the Animal Pathology Laboratory. These ewes were maintained during the summer of 1964 on pasture land that had been grazed by parasitized sheep the previous year. Furthermore, since no spring or summer anthelmintic treatment of this group was carried out in 1964, the ewes were likely to have acquired significant nematode infections during their sum-



*Low Larval Yield
Fig. 5. Ova and Larval Count Values for Ewe No. 826.

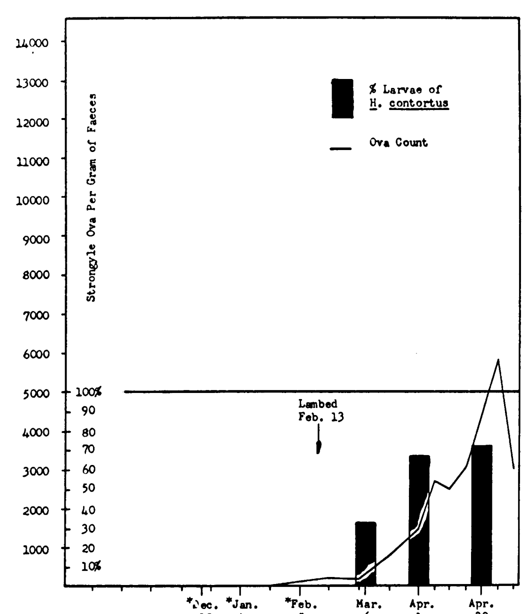


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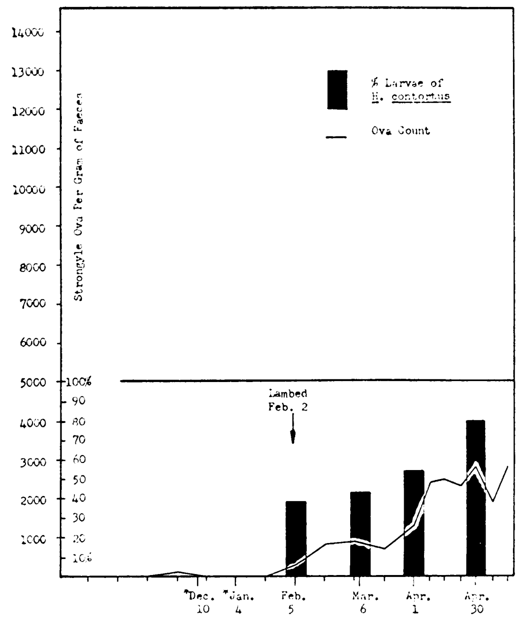
Fig. 6. Ova and Larval Count Values for Ewe No. 833.



*Low Larval Yield
Fig. 7. Ova and Larval Count Values for Ewe No. 836.

mer on pasture.

During the winter stabling period, the 18 ewes were housed together in an unheated barn on deep litter and were fed a conventional winter maintenance ration consisting of hay and low level grain supplementation. No attempts were made to prevent reinfection of the ewes by infective larvae present in the manure but previous experience (11) had shown that under these conditions this possibility was unlikely.

On February 2, 1965, nine of the 18 ewes used in the experiment were treated with thiabendazole at the rate of 100 mg/kg. of body weight. The remaining nine ewes remained untreated and no changes were made in the housing and management of the two sub-groups thereafter designated Groups A (Treated) and B (Untreated).

Two additional experimental groups were established and consisted of five unbred cull ewes (Group C) and five rams (Group D) of mixed age and breed. Both groups were penned separately and their management and housing conditions were similar to those of the 18 bred ewes.

Faecal samples were collected *per rectum* from all individual sheep and strongyle ova counts were determined on each sample by the McMaster Flotation technique (12). The ova counts were conducted bimonthly except during the latter part of the experimental period (April 1 to May 13) when the bred ewes of Groups A and B were sampled each week. Additional faecal samples were collected at approximate monthly intervals from each of the bred ewes in Group B (Untreated) and nematode ova obtained from these samples were incubated at 27-30°C for 24 hours to permit the hatching of first stage (L_1) larvae. Identification of harvested larvae made it possible to assess the proportions of various types of strongyle ova being passed in the faeces of these nine ewes during the experimental period. The techniques employed in the recovery of ova from faeces and in the hatching, recovery and identification of larvae have been described in detail by Whitlock (13). In Whitlock's original method, ova were concentrated and washed with the aid of a Buchner filter-funnel and pressure flask whereas, in the present work, a system of double centrifugation was adopted as an alternate method in an effort to increase the potential ova yield.

Results

The mean faecal ova counts for the bred ewes of Group A (Treated) and B (Untreated) are illustrated graphically in Fig. 1. Following treatment with thiabendazole on February 2, 1965, the ewes of Group A were found to pass strongyle ova in their faeces at a relatively constant, low level

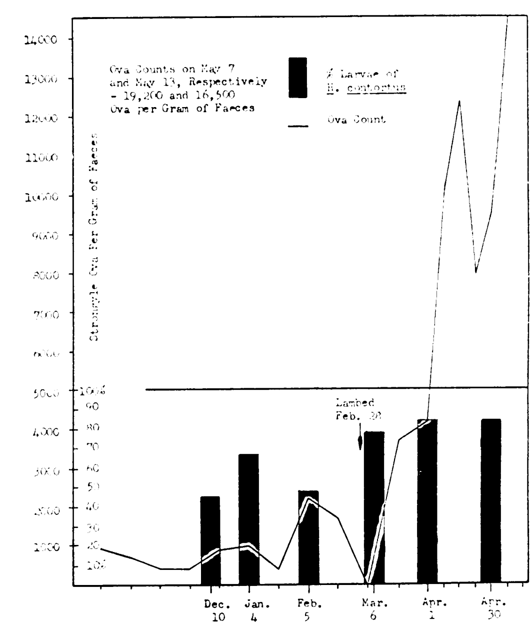
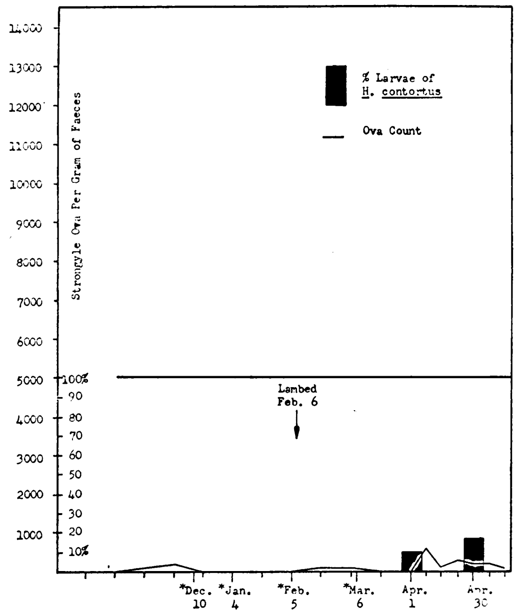
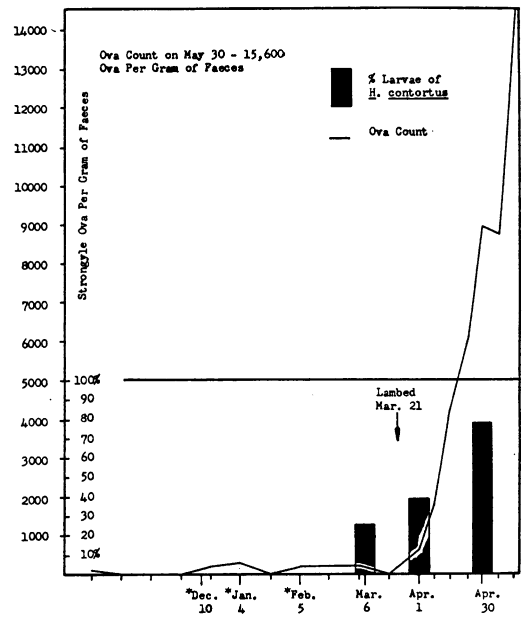


Fig. 8. Ova and Larval Count Values for Ewe No. 843.



*Low Larval Yield
Fig. 9. Ova and Larval Count Values for Ewe No. 847.



*Low Larval Yield
Fig. 10. Ova and Larval Count Values for Ewe No. 862.

until the termination of the experiment. The mean faecal ova counts of the untreated ewes (Group B), however, displayed an abrupt rise which commenced on March 5 and achieved its maximum value of 5880 e.p.g.[2] on May 7.

The ova count trends observed in individual untreated ewes (Group B) are illustrated graphically in Figs. 2 to 10, together with histograms charting the percentage of *H. contortus* ova passed in the faeces of each ewe at intervals during the trial period. These latter values were determined on the basis of the identification of first stage larvae hatched from strongyle ova which were harvested from the faeces of the experimental animals.

Of the nine ewes whose ova counts were examined throughout this study, two (847 and 806) failed to develop a marked spring rise. In the case of the former ewe, larval identification revealed that at no time did *H. contortus* ova comprise a major portion of the total number of strongyle ova passed in the faeces. The latter ewe was shedding high levels of ova of *H. contortus* in her faeces on March 6 and April 1 even though the total ova counts at these times were low. Unlike ewe 847, however, ewe 806 lambed late in the experiment on April 5 and faecal sampling was discontinued before it could be determined whether or not she would develop a spring rise.

Each of the remaining seven ewes of Group B developed a well-defined spring rise in faecal ova output following her lambing. The temporal relationship to lambing and the magnitude, duration and pattern of the rises showed considerable variation. Furthermore, since maximum ova count values were achieved almost simultaneously, the timing of the rises in this study seemed to be independent of the lambing dates of individual ewes. It is nevertheless apparent, in each case, that large percentages of the strongyle ova passed in the faeces of the ewe during her rise were ova of *H. contortus*. It is further evident, in these seven ewes, that as the faecal ova counts increased to their maximum values, so also increased the proportions of ova of *H. contortus* relative to all other strongyle ova types.

In Fig. 11, a progressive rise can be seen in the mean ova count of the five unbred ewes of Group C. This increase commenced after January 4, 1965, and achieved its maximum value (2100 e.p.g.) on April 29, 1965. Although this trend suggests that spring rise occurred among the unbred ewes, the rise was, in fact, influenced largely by one ewe whose ova count began to

e.p.g.[2] — eggs (ova) per gram.

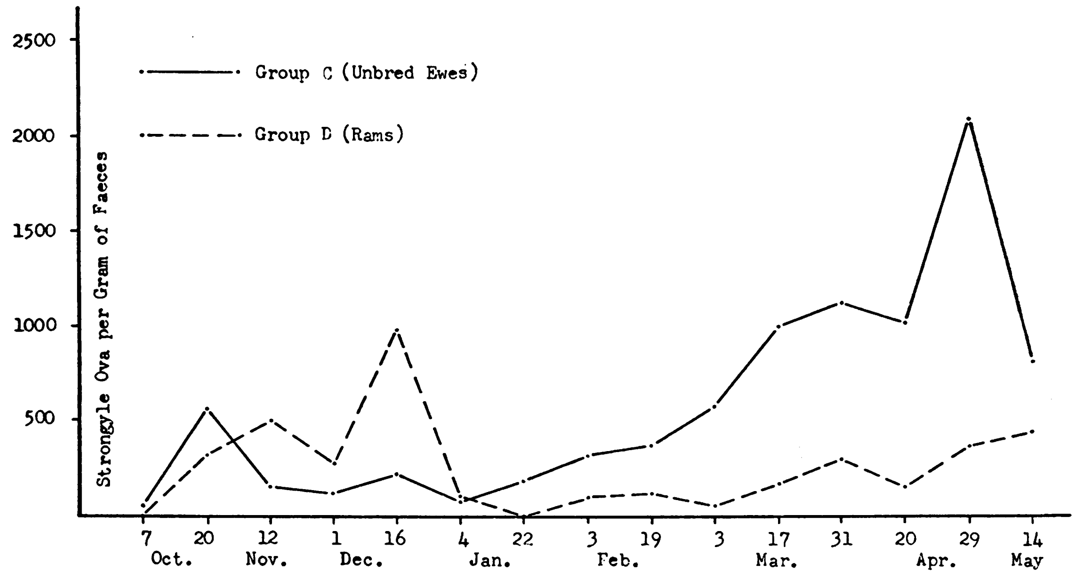


Fig. 11. Mean Strongyle Ova Counts of Unbred Ewes and Rams.

increase on January 4, 1965 and reached a peak value of 6000 e.p.g. on April 29, 1965. The rise in this ewe occurred synchronously with those observed in the post-parturient animals but was thought to be associated primarily with her declining health.

After January 22, 1965, a gradual increase occurred in the mean faecal ova count of the rams of Group D. This was of low magnitude, and little significance was attached to it. Likewise, no importance was associated with the increased values for the group on November 12 and December 16 since they were caused by the high ova counts of one ram only.

Discussion

The causes underlying the spring rise phenomenon cannot clearly be defined but this apparent burst of regenerative activity on the part of nematodes parasitic in ewes may well serve as a major source of infective larval stages for the subsequent development of nematodiasis in lambs on pasture. Thus, spring rise may closely be related to the epidemiology of nematode parasitism in populations of young and susceptible lambs. As Crofton (6) has pointed out, a high rate of ova production by a group of ewes at six to eight weeks after lambing and of several weeks' duration, would make available a nucleus of infective stages for the young and susceptible lambs. In this way, the spring rise might act as a primer to the main period of multiplication in lambs and, if so, the potential of each ovum passed in the faeces would be relatively high. The results of the present study indicate that spring rise in the Montreal area may have a particular bearing on the problem of haemonchosis in lambs.

Crofton's suggestion has since been substantiated by Brunsdon (14) in a recent field experiment involving a group of lambs grazed with ewes whose post-parturient rise was prevented by anthelmintic therapy and a second group of lambs grazed with their untreated mothers. During the last four weeks of the trial when the lambs were five to six months old, the ova counts of lambs running with untreated ewes rose rapidly to a high level. At the end of the trial, the mean ova count of lambs of treated ewes was lower than that on the first sampling date 14 weeks previously. Similarly, post-mortem worm counts were significantly lower in lambs which had been running with treated ewes and the mean liveweight gain of these lamb was five lbs. higher than that of lambs of untreated ewes.

Spring rise, furthermore, may permit the survival of many nematode species from year to year within sheep flocks in northern latitudes. Certain of the common sheep nematodes (*Nematodirus spp.* and

Ostertagia spp.) are able to pass the winter months on pasture as infective larvae, unharmed by low temperatures. Large numbers of individuals, however, of many nematode species of sheep, are destroyed during winter on pastures in this area. Those nematodes, therefore, that spend the winter months within the protected environment of the host's gastrointestinal tract, may constitute the bulk of the surviving population of such species. Since breeding stock, by reason of age and previous exposure, have some degree of resistance to internal parasitism, the number of adult parasites passing the winter within such hosts is generally low. Thus, the ability to generate large numbers of infective stages in the springtime may be essential to the survival of some nematode species within a sheep flock.

In the present work, the occurrence, in seven of nine post-parturient ewes, of marked increases in faecal ova output, confirms the importance of the breeding ewe as a major potential source of infective stages for the crop of young lambs. The successful prevention of the post-parturient rise by treatment with thiabendazole in a similar group of ewes indicates that preparturient anthelmintic therapy of the breeding flock could eliminate this threat to the lamb population.

Although a spring rise was noted in one of a group of unbred ewes, the findings suggest that maximum expression of the phenomenon is seen only in post-parturient, lactating animals. This is supported by the observation of Crofton (6) that spring rise occurs less frequently in unbred ewes than in breeding stock.

The present attempt to identify the nematode species contributing most to the increased ova counts of ewes during spring rise was prompted by previous observations (11) on an outbreak of winter parasitism in which *H. contortus* was the primary pathogen. It seemed likely, in view of the extensive oogenetic capacity of *H. contortus* (15), that ova of this nematode should comprise the major portion of the total number of strongyle ova passed in the faeces of ewes experiencing spring rise in this area. The results of the present work bear out this contention since, subject to individual variation, substantial proportions of *H. contortus* ova were present during spring rise. Increased levels, furthermore, were found to parallel elevations in the absolute number of strongyle ova passed in the faeces.

It thus appeared, in the present study, that *H. contortus* was the major contributor to the spring rise phenomenon. Furthermore, it can be anticipated that in sheep flocks and in sheep-raising areas where *H. contortus* infection is endemic, spring rises of magnitudes comparable to those herein recorded will occur.

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