The Journal of Agriculture of the University of Puerto Rico

In continuation of The Journal of the Department of Agriculture of Puerto Rico
Published by THE AGRICULTURAL EXPERIMENT STATION, Rio Piedras, P. R.

Published Quarterly: January, April, July and October of each year.

VOL. XXIV October 1940 No. 4

A PRELIMINARY NOTE ON THE INTERNAL PARASITES OF PUERTO RICAN CATTLE WITH SPECIAL REFERENCE TO THOSE SPECIES FOUND IN CALVES SUFFERING FROM "TROPICAL DIARRHEA" *

By JOHN S. ANDREWS
AND
JOSÉ F. MALDONADO

INTRODUCTION

In Puerto Rico many calves suffer from a condition locally known as "tropical diarrhea." This condition, according to information obtained from farmers who are familiar with its clinical aspects, usually appears in young calves shortly after they have been turned out to pasture. The affected animals develop anorexia, diarrhea, and anemia, become weak and emaciated, and many of them die. In some sections of the Island "tropical diarrhea" has made the raising of calves almost impossible, with the result that many dairymen have been forced to buy cattle locally or to import them in order to replace normal losses in their herds.

In December 1938 the Puerto Rico Agricultural Experiment Station in cooperation with the School of Tropical Medicine, began a series of investigations to determine the relationship between the occurrence of "tropical diarrhea" in cattle on the island and the presence of infestations with gastro-intestinal parasites in the affected animals. Although Dikmans (3) and Van Volkenberg (10, 18) published the results of parasitological examinations of cattle in the vicinity of Mayaguez, P. R. and Catalá (2) and Van Volkenberg (10, 11, 12, 13, 14, 15, 16, 17) associated certain parasites with definite clinical symptoms of disease, the specific relationship between the presence of these parasites and the syndrome called "tropical diarrhea" was not studied by these workers. It was, therefore, necessary to undertake a survey as a preliminary step

* Cooperative project between the Agricultural Experiment Station of the University of Puerto Rico and the School of Tropical Medicine.

in the present study of "tropical diarrhea" in order to identify the parasites occurring in the affected animals. The species which appeared to have a causal relationship to the condition could then be selected for further experimental investigation.

A list of parasites collected during this survey has already been published in the Annual Report of the Puerto Rico Agricultural Experiment station for 1938-39, and a supplementary list is now in press as part of the Report for 1939-40. Detailed information concerning the frequency of the occurrence of the parasites encountered or the relative importance of these species found in calves suffering from "tropical diarrhea," however, was not included in these reports. This information plus data on the ages of the animals affected and the geographical and seasonal distribution of the cases of "tropical diarrhea" observed are included in the present note. Since these data for the most part were obtained from calves voluntarily sacrificed by the owners, they are not as comprehensive as might be desired. They appear, however, to furnish a basis for further experimental work on the problem.

Data Obtained

Twenty-two calves were autopsied during this survey. The species of parasites recovered from these calves arranged in order of their occurrence, but without regard to the severity of the individual infestations, are recorded in table 1.

TABLE 1. THE INTERNAL PARASITES RECOVERED AT AUTOPSY FROM 22 CALVES ARRANGED ACCORDING TO THE FREQUENCY OF THEIR OCCURRENCE IN THESE ANIMALS

Name of parasite	Organ parasitized	Number of calves infested	Percentage of calves infested
Bunostomum phlebotomum	Small intestine	17	77.3
Oesophagostomum radiatum	Large intestine	14	63.6
Cooperia punctata	Small intestine	12	54.5
Haemonchus contortus	Abomasum	11	50.0
Trichuris ovis	Large intestine	9	40.9
Dictyocaulus viviparus	Lungs	5	22.7
Haemonchus similis	Abomasum	5	22.7
Moniezia spp.	Small intestine	5	22.7
Ostertagia ostertagi	Abomasum	4	18.0
Setaria labiatopapillosa	Body cavity	3	13.6
Strongyloides papillosus	Small intestine	3	13.6
Trichostrongylus axei	Abomasum and small intestine	3	13.6
Capillaria longipes	Small intestine	2	9.0
Capillaria sp.	Small intestine	2	9.0
Cooperia curticei	Small intestine	2	9.0
Cooperia pectinata	Small intestine	2	9.0
Eimeria zurni	Large intestine	2	9.0
Fasciola hepatica	Liver	2	9.0
Syngamus laryngeus	Trachea	2	9.0
Cotylophoron cotylophorum	Rumen	1	4.5
Trichostrongylus colubriformis	Small intestine	1	4.5

The data in table 1 show that the four gastro-intestinal parasites occurring most frequently in the 22 calves were *Bunostomum phlebotomum*, the common hookworm of cattle, *Oesophagostomum radiatum*, the nodular worm, *Cooperia punctata*, a small nematode living in the small intestine, and *Haemonchus contortus*, the large stomach worm, respectively. As shown in table 2, these same four species of parasites were also recovered in relatively large numbers from calves suffering from "tropical diarrhea." With the exception of *Dictyocaulus viviparus*, the lungworm, which was found to be the cause of verminous pneumonia in 3 calves, and *Eimeria zurni*, a coccidium, which will be discussed in connection with the data given in table 2, the remainder of the parasites shown in table 1 were present in such small numbers as to be of little pathogenic importance.

Eight of the 22 calves autopsied were found to be suffering from "tropical diarrhea" as was indicated by the presence of typical symptoms of the disease. The data obtained from these 8 calves together with data from another calf which could not be autopsied are recorded in table 2.

According to the data in table 2, the calves suffering from "tropical diarrhea" ranged in age from 2 to 11 months. Eight of the 9 cases were observed during the first 3 months of the calendar year. Only one case was seen as late as June. Five of the affected calves came from the Central mountainous region of the Island, 2 came from the North and 2 from the South coastal plain.

TABLE 2. DATA OBTAINED FROM CALVES SUFFERING FROM "TROPICAL DIARRHEA"

Calf No.	Approximate age in months	Date of examination	Geographical location	Species of gastro-intestinal parasites recovered					
				Haemonchus contortus	*Bunostomum phlebotomum*	*Cooperia punctata*	*Strongyloides papillosus*	*Oesophagostomum radiatum*	*Eimeria zurni*
1	2	1/20/39	Cayey-Central mountainous section	2,000	326	very few	0	0	0
2	10	1/20/39	Cayey-Central mountainous section	6	33	3,000	0	0	0
3[1]	2	6/16/39	Morovis-Central mountainous section	0	0	0	x[2]	0	x
4	3	1/15/40	Palo Seco-North coastal plain	0	1	5,000	0	0	0
5	4	2/1/40	Bayamón-North coastal plain	267	57	6,000	0	0	0
6	8-9	2/16/40	Orocovis-Central mountainous section	0	800	126,000	0	6,000	0
7	8-9	2/16/40	Orocovis-Central mountainous section	0	80	very few	0	47	0
8	10-11	3/15/40	Ponce-South coastal plain	0	136	very few	0	1	x
9	10-11	3/15/40	Ponce-South coastal plain	0	5	very few	0	88	x

[1] The data from calf 3 were obtained from fecal samples.
[2] "x" is used to denote heavy infestations which could not be expressed numerically.

DISCUSSION OF INDIVIDUAL CASES

Calf 1

Calf 1 was approximately 2 months old and died on the night of January 19, 1939, weighing less than when it was born according to the owner. It had been on a hillside pasture consisting of malojillo grass (*Panicum purpuracens Raddi*) with its mother since birth. It had suffered from diarrhea for some time and at autopsy it was found to be very anemic. The three species of gastro-intestinal parasites harbored by this calf which were also recovered from other calves suffering from diarrhea are listed in table 2.

Since calf 1 received practically all of its nourishment from the cow the symptoms observed did not appear to be due to malnutrition. However, the stomach-worm and hookworm infestations, which had undoubtedly been picked up from the pasture, seemed to be sufficient to account for the symptoms observed. The anemia present could very easily have been caused by these nematodes alone, since both species are known to cause severe hemorrhage. It is also probable that the hookworm infestation was a factor in the production of the diarrhea. The infestation with *C. punctata,* on the other hand, was considered to be too small to be of any pathogenic importance, although the findings of Ransom (6), Hung (5), and Dikmans (4) have indicated that this species is capable of causing extensive lesions in the wall of the small intestine of heavily infested calves.

Calf 2

Calf 2 was 10 months old at the time it was killed for autopsy. It had been grazing on a malojillo pasture without proper supplementary feeding and was suffering from diarrhea but was not anemic. It was extremely small for its age and was in very poor physical condition.

Although the lack of proper feeding was undoubtedly partly responsible for the small size of this calf, it is almost certain that the relatively large infestation with *C. punctata* observed contributed to the production of the diarrhea. (See references mentioned in connection with the discussion of the data obtained from Calf 1.) The absence of anemia together with the very light infestations with stomach-worms and hookworms strengthens the hypothesis that the anemia in calf 1 was largely due to infestation with these two species of parasites.

Calf 3

Calf 3 was about 2 months old and was suffering from a severe and very bloody diarrhea at the time of observation. This calf could not be

autopsied, but fecal samples were obtained and examined for evidences of parasitic infestation. Great numbers of eggs of *Strongyloides papillosus*, together with thousands of merozoites and oocysts of *Eimeria zurni* were found in the feces.

Since, so far as could be ascertained, the diet of this calf was satisfactory, the observed pathological condition appeared to be caused primarily by the coccidial infestation. The effects of the *Strongyloides* infestation, however, cannot be ruled out entirely, since this nematode has been reported by Roberts (*7*) as responsible for diarrhea in a 3-months-old calf.

Calf 4

Calf 4 was about 3 months old and had been raised for the first 2 months of its life in a pen having a concrete floor. During this period it had been fed milk from a bucket and was occasionally allowed access to a grass plot near the pen. For the month previous to autopsy it had grazed with other calves in a nearby grapefruit grove. The calf was very thin and weak, but was not anemic. It had a persistent cough and was suffering from diarrhea at the time of autopsy.

Although pneumonia was apparently the fundamental cause of the unthrifty condition of this calf, the relatively heavy infestation with *C. punctata* was undoubtedly responsible for the diarrhea observed.

Calf 5

Calf 5 was about 4 months old and had been raised with several other calves on a luxuriant malojillo pasture. Seven of the calves belonging to this group had died within the previous 3 months with symptoms of diarrhea and weakness. Calf 5 had been on the pasture for 3 months and had had diarrhea for 1 month prior to autopsy. It weighed approximately 50 per cent of normal but was not anemic.

At autopsy a relatively heavy infestation with *C. punctata* was found which was apparently responsible for the diarrhea observed. The infestations with stomach-worms and hookworms were too light to have contributed to the pathological picture.

Calves 6 and 7

These two calves were between 8 and 9 months old and belonged to a group of 30 calves which had been brought to the mountains 5 to 6 months previously. They had been put on a pasture containing malojillo and elephant grass (*Pennisetum purpureum Schum*), but were given no supplementary ration. Eleven of the 30 calves had died during the previous month. The remaining animals were thin and weak. Some of

them were anemic and exhibited the characteristic "bottle-jaw" seen in many such cases.

Calf 6 was very anemic and was suffering from severe diarrhea at the time of autopsy. As is shown in table 2, this calf harbored the heaviest parasitic infestation encountered. Hookworms, *C. punctata,* and nodular worms were present in such large numbers that the condition of the calf could not be ascribed to any one species. Sections of the small intestine revealed larvae of *C. punctata* in the mucosa showing, for the first time during the present study, that this nematode was causing definite pathological changes.

Calf 7 was in a much poorer physical condition than calf 6. It was also suffering from diarrhea, but did not exhibit as severe an anemia. Although the number of adult parasites recovered was relatively insignificant, there was an incipient *O. radiatum* infestation. The inflamed and edematous condition of the ileum and cecum caused by the larvae of this nematode appeared to be sufficient to account for the diarrhea observed.

Although these calves received no supplementary ration, the pasture was in good condition so that very little if any of the symptoms observed could be attributed to malnutrition It appears, therefore, that the symptoms observed in these two calves were primarily due to the nematode infestations harbored. The difference in the parasitic infestations found in calves 6 and 7 is indeed remarkable considering the fact that both animals grazed the same pasture under the same conditions for approximately the same length of time. This fact coupled with the observation that the physical condition of calf 7 was worse than that of calf 6 seems to point to the great importance of individual differences in the response of the animals concerned, not only to the kind of feed available, but to the effects of parasitic infestations harbored.

Calves 8 and 9

These two calves were grade Brahmas between 10 and 11 months old and were taken for autopsy from two farms having no direct connection. The calves were not in good physical condition because of the extreme dryness of the pasture which served as their only source of food. Water was obtained from isolated water holes which were contaminated with the feces of the animals drinking from them. These two calves were suffering from a severe diarrhea but were not anemic.

Both calves were found at autopsy to be infected with *Eimeria zurni,* a common cattle coccidium. The wall of the cecum in the neighborhood of the ileocecal valve was thickened and hemorrhagic, and was teeming

with merozoites and oocysts of *E. zurni*. Since the number of other species of parasites was negligible, the coccidial infection alone appeared to be responsible for the diarrhea observed in these animals.

Infestations with *E. zurni* are very often found in healthy cattle which apparently have sufficient natural resistance to prevent these parasites from becoming pathogenic. In the case of calves 8 and 9, however, the prevailing dry weather conditions had apparently so reduced the nutritive value of the pasture that the resistance of these animals was lowered to the point where the parasites were able to become pathogenic and to produce clinical symptoms.

DISCUSSION

The foregoing data show that all of the cases of "tropical diarrhea" observed occurred in calves from 2 to 11 months old, and that the condition was not limited to any one region of the island. Although 8 of the 9 cases were observed during the first 3 months of the calendar year, this condition cannot be said to be "seasonal" since there are no definite seasons in Puerto Rico which are comparable to those in temperate zones. The data further indicate that the cases of "tropical diarrhea" studied can be classified into 3 groups as follows:

Group 1, in which malnutrition was apparently a complicating factor.

Calf No.	*Gastro-intestinal parasites present*
2	*Cooperia punctata*
8	*Eimeria zurni*
9	*Eimeria zurni*

Group 2, in which bacterial infection was apparently a complicating factor.

4	*Cooperia punctata*

Group, 3 in which there was no apparent complicating factor.

1	*Haemonchus contortus* *Bunostomum phlebotomum*
3	*Eimeria zurni* *Strongyloides papillosus*
5	*Cooperia punctata*
6	*Bunostomum phlebotomum* *Cooperia punctata* *Oesophagostomum radiatum*
7	*Bunostomum phlebotomum* *Oesophagostomum radiatum*

These results show that the cases of "tropical diarrhea" observed during this study, although sometimes complicated by malnutrition or bacterial infection, were always associated with relatively large infesta-

tions consisting of one or more of six species of gastro-intestinal parasites, namely, *B. phlebotomum, O. radiatum, C. punctata, H. contortus, S. papillosus,* and *E. zurni.*

Catalá (2) stated that the principal internal parasites found by him in Puerto Rican calves suffering from diarrhea, anemia, and emaciation were *O. radiatum, Uncinaria radiata* (*B. phlebotomum*), and *Ascaris vitulorum.* Van Volkenberg (15) considered *B. phlebotomum, O. radiatum, H. contortus,* and *Eimeria* spp. of pathogenic importance in Puerto Rican cattle. Although he admitted the possible injurious effects of *C. punctata* and *S. papillosus,* this author felt that these two species were of relatively less importance than the parasites previously mentioned by him. In addition Van Volkenberg reported *Moniezia expansa* and the young forms of *C. cotylophorum* as associated with cases of diarrhea in calves.

Roberts (7) recovered 11 species of gastro-intestinal helminths from Australian cattle which he considered of pathogenic importance. These parasites were associated with diarrhea, anemia, and, in some instances, with emaciation, occurring in calves 4 to 12 months old. Five of these 11 species have already been mentioned in connection with the results obtained from the present survey. Six species, *O. ostertagi, T. axei, C. pectinata, Moniezia benedeni,* the young forms of *Paramphistomum cervi* and *P. explanatum; Cooperia oncophora,* reported by Baker (1), *Nematodirus helvetianus,* reported together with *C. oncophora* and coccidia, by Tunnicliff (9), as the apparent cause of diarrhea in calves; and an unidentified species, which may be *Mecistocirrus digitatus,* reported by Sheather (8) as pathogenic for Indian calves (according to Roberts), have not yet been associated with "tropical diarrhea" as it occurs in Puerto Rico.

Roberts (7) has pointed out that 3 of the 6 species recovered from the cases of "tropical diarrhea," observed during the present study, namely, *B. phlebotomum, O. radiatum* and *H. contortus* have been repeatedly associated with cases of parasitic gastro-enteritis calves. As has been shown earlier in this paper the remaining 3 species have also been recovered from diarrheic calves by other workers. Since the symptoms shown by calves suffering from "tropical diarrhea" were found to be very similar to those reported for calves in temperate climates known to be suffering from parasitic gastro-enteritis, and since the species of parasites recovered from typical cases of "tropical diarrhea" have also been found in calves known to be suffering from parasitic gastro-enteritis, the present observations appear to suggest the possibility that "tropical diarrhea" of cattle in Puerto Rico may be caused by para-

sitic infestation. If this hypothesis is proved to be correct, the number of different species of parasites associated with this condition will undoubtedly be increased as additional cases are studied.

CONCLUSIONS

1. "Tropical diarrhea" so far as the condition in Puerto Rico is concerned is not a specific disease entity. It does not differ in any way from similar conditions occurring in cattle in temperate zones.

2. It is not seasonal in occurrence, nor is it confined to any definite portion of the island.

3. "Tropical diarrhea" as it occurs in Puerto Rico, may be due to infestation with various animal parasites.

4. The fact that 4 of the 6 species of gastro-intestinal parasites found in the calves suffering from "tropical diarrhea" were the species found most frequently in all of the calves examined, suggests that their probable relation to the disease should be further investigated.

SUMMARY

The results of a survey of the internal parasites of Puerto Rican cattle made as a preliminary step in connection with investigations on "tropical diarrhea" in calves have shown that the four most common species of gastro-intestinal parasites in the 22 calves autopsied were, *B. phlebotomum* (77.3%), *O. radiatum* (63.6%), *C. punctata* (54.5%), and *H. contortus* (50%).

Eight of the 22 calves and one calf not autopsied were found to be suffering from "tropical diarrhea." These nine calves were from 2 to 11 months old and were about evenly divided between the central mountainous section and the north and south coastal plains. Eight of the nine cases occurred during the first 3 months of the calendar year. One occurred in June.

E. zurni, together with the four species of nematodes just mentioned were recovered in large numbers from calves suffering from "tropical diarrhea." The nematode, *S. papillosus,* was also implicated in one case as the result of finding large numbers of eggs in the feces of a calf. The remainder of the 21 species of parasites listed, with the exception of the lung worm, *D. viviparus,* which was found to be the cause of verminous pneumonia in 3 calves, were considered to be of little pathogenic importance in the calves examined.

Three of the 9 cases of "tropical diarrhea" appeared to be due to a combination of malnutrition and heavy infestation with gastro-intestinal

parasites. One case was apparently caused by gastro-intestinal parasites combined with bacterial infection (pneumonia), and 5 cases appeared to be due to infestation with gastro-intestinal parasites alone.

Twelve species of parasites in addition to the 6 already mentioned have been reported by other workers as apparently responsible for cases of gastro-enteritis in calves, namely, *O. ostertagi, T. axei, C. oncophora, C. pectinata, N. helvetianus, A. vitulorum, M. benedeni, M. expansa, M. digitatus,* and the young forms of *C. cotylophorum, P. cervi,* and *P. explanatum. C. oncophora, N. helvetianus, A. vitulorum, M. digitatus* and the young forms of the 3 species of trematodes were not encountered in any of the calves autopsied. The remaining parasites were present in such small numbers that they were considered to be of little pathogenic importance.

It was concluded that since "tropical diarrhea" does not differ from similar conditions occurring in calves in temperate zones which have been definitely associated with infestation with gastro-intestinal parasites, and, since 4 of the 6 species of parasites found to be present in large numbers in calves suffering from this condition, were the species found most commonly in all of the calves examined, that the probable relationship of parasitic infestation to "tropical diarrhea" should be further investigated.

ACKNOWLEDGMENT

The assistance of Mr. José F. Maldonado was made possible through funds supplied by the Puerto Rico Reconstruction Administration. The laboratory facilities necessary for this work were furnished by the School of Tropical Medicine.

LITERATURE CITED

1. **Baker, D. W.** Parasitic gastroenteritis of calves. Cornell Vet. **27**: 381-394. 1937.
2. **Catalá, J. V.** Principales parásitos intestinales de la res bovina de Puerto Rico. Rev. de Agric. **24** (9): p. 112. March 1930.
3. **Dikmans, G.** Report of the Parasitologist for the years 1924-26. In Report of the Porto Rico Agricultural Experiment Station, Mayaguez, P. R. **1927**: 26-28. 1929.
4. ———. Parasitic enteritis in calves. Vet. Med. **34**(1): 3 pp. 1939.
5. **Hung, See-Lu.** The pathology of *Cooperia punctata* infestation in calves. N. Amer. Vet. **7**(3): 33-36. 1926.
6. **Ransom, B. H.** Intestinal lesions in calves due to *Cooperia punctata.* Jour. Parasit. **7**(2): 96. 1920.
7. **Roberts, F. H. S.** The gastro-intestinal helminths of cattle in Queensland. Their distribution and pathogenic importance. Proc. Roy. Soc. Queens. **50**(9): 46-54. 1939.

8. **Sheather, A. L.** A new nematode causing parasitic gastritis in calves. Agric. Res. Inst. Pusa, Bull. 86 (From Roberts (7)). 1919.
9. **Tunnicliff, E. A.** The occurrence of *Cooperia oncophora* and *Nematodirus helvetianus* in calves. Jour. Amer. Vet. Med. Ass. **33**(2): 250-251. 1932.
10. **Van Volkenberg, H. L.** Report of the Parasitologist for the year 1927. In Report of the Porto Rico Agricultural Experiment Station, Mayaguez, P. R. **1927:** 28-31. 1929.
11. Report of the Parasitologist for the year 1929. idem **1929:** 26-29. 1930.
12. Report of the Parasitologist for the year 1930. idem **1930:** 38-40. 1931.
13. Report of the Parasitologist for the year 1932. idem **1932:** 21-23. 1933.
14. Report of the Parasitologist for the year 1933. idem **1933:** 19-22. 1934.
15. Parasites and parasitic diseases of cattle in Puerto Rico. Puerto Rico Agricultural Experiment Station, Mayaguez, P. R. Bull. 36: 1-26. 1934.
16. Animal Parasites. In Report of the Puerto Rico Agricultural Experiment Station, Mayaguez, P. R. **1934:** 20-24. 1935.
17. Animal Parasitology. idem **1935:** 23-26. 1936.
18. Check list of parasites found among principal domestic animals in Puerto Rico. Proc. Helm. Soc. of Wash. **5**(1): 7-8. 1938.

SUMARIO

Los resultados obtenidos en un reconocimiento, como estudio preliminar de los parásitos internos del ganado bovino, para investigaciones en relación con las "diarréas tropicales" de los becerros nos demuestran, juzgando por los 22 animales examinados en sus autopsias, que los cuatro parásitos gastrointestinales mencionados a continuación son los encontrados más comunmente: el *Bunostomum phlebotomum* (77.3%), el *Osophagostomum radiatum* (63.6%), el *Cooperia punctata* (54.5%), y el *Haemonshus contortus* (50%).

Ocho de los becerros examinados en autopsias más uno sin examen *post-morten* estaban afectados con "diarréas tropicales." Estos nueve becerros fluctuaban entre 2 a 11 meses de edad y su procedencia puede decirse que es representativa de las condiciones de la isla porque provenían de las secciones montañosas del centro de la isla, así como del litoral Norte y Sur. Ocho de los nueve casos se manifestaron durante los tres primeros meses del año natural y el otro en junio.

El organismo *Eimeria zurni* siempre se encontraba presente en los casos de "diarréas tropicales" conjuntamente con los otros cuatro nematodos mencionados. El nematodo *Strongyloides papillosus* fué también muy notable en un caso, como resultado de encontrarse un gran número de sus huevos en las heces fecales de un becerro. El resto de las 21 especies de parásitos internos en la lista, con la excepción del gusano o bichillo pulmonar, *Dictyocaulus viviparus,* el cual hemos encontrado que

es causante de la pulmonía verminosa en tres becerros, los consideramos de poca importancia patogénica en todos los animales examinados.

Tres de los nueve casos de "diarréas tropicales" parece que son causados por una combinación de mala nutrición e infecciones fuertes de los parásitos gastrointestinales. Un solo caso aparecía como causado por parásitos gastrointestinales combinado con infecciones bacteriológicas (pneumonia) y cinco de ellos se encontraron ser causados por infecciones de parásitos gastrointestinales solamente.

Otros investigadores han encontrado doce especies de parásitos gastrointestinales, además de los seis mencionados por nosotros como consecuentes de trastornos de gastroenteritis de los becerros.

Estos parásitos son: *Ostertagia ostertagi, Trichostrongylus axei, C. oncophora, C. pectinata, N. helvetianus, A. vitulorum, M. benedeni, M. expansa, M. digitatus y las formas juveniles del C. cotylophorum, P. cervi y P. explanatum. C. oncophora, N. helvetianus, A. vitulorum, M. digitatus* y las formas juveniles de los tres trematodos o sea, los estados iniciales, no se encontraron en ningún momento en las autopsias de los becerros examinados. Todos los demás parásitos internos presentes en los exámenes fueron en tan pequeño número o escasa importancia que no le hemos dado ninguna importancia patogénica.

Se llegó a la conclusión, que dado el caso de que las "diarréas tropicales" no se diferencian de los casos similares ocurrentes en becerros de la zona templada, los cuales se asocian definitivamente con infecciones de parásitos gastrointestinales y toda vez que 4 de las 6 especies de parásitos encontrados se hallaban en gran número en todos los becerros enfermos, siendo a la vez las especies que se encontraban más comunmente en todos los exámenes. La relación probable entre infecciones parasitarias y las "diarréas tropicales" debe seguir investigándose.