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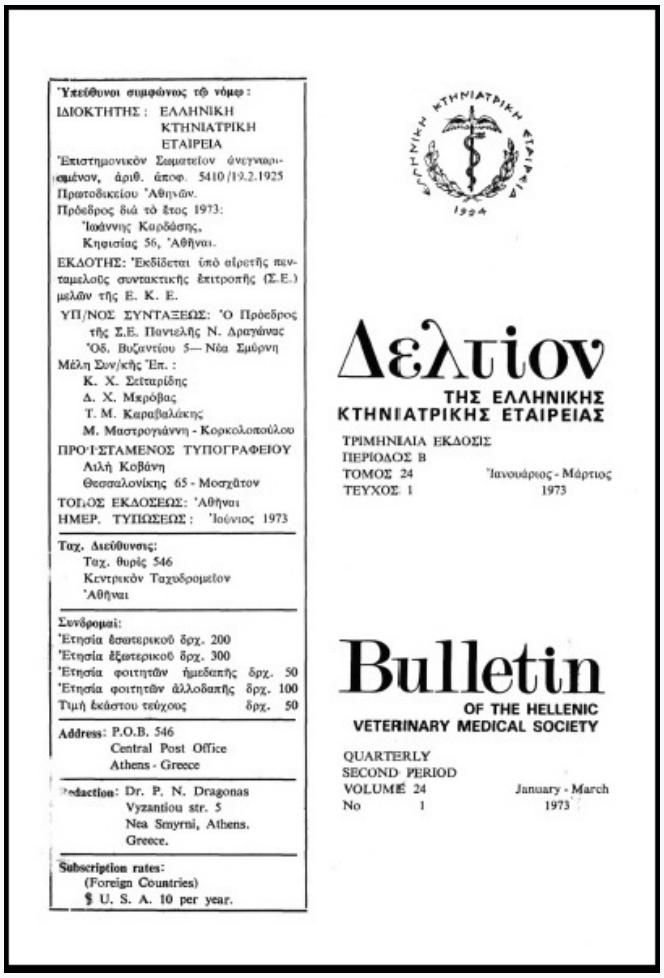

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BALANTIDIUM IN BOVINE RESPIRATORY TRACT

B. C. HATZIOLOS

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Departments of Veterinary Science and Animal Health
University of Maryland, College Park, Maryland 20740

BALANTIDIUM IN BOVINE RESPIRATORY TRACT*

By

BASIL C. HATZIOLOS

The occurrence of pathologic conditions in domestic animals due to Balantidium Sp. is rare except in swine, in which it may cause diarrhea, hemorrhagic colitis, and death. The few cases reported concerning the incidence in other animals do not provide data on pathogenic manifestations.

B a l a n t i d i u m c o l i in the intestinal tract of cattle and buffalo has been reported in India[5,13,16,40,42,a], New Zealand[17] and Italy [37,39]. Levine[33] believes that the Balantidium reported in cattle belonged to the genus B u x t o n e l l a, (Jameson, 1926) var. s u l c a t a, common in the cecum of the ox, zebu, and water buffalo.

B. c o l i infection has also been reported in sheep[10,26], goats[1], horses[9,14,22] and dogs [4,18,20,21,25]. In most of these cases, the infected animals were directly or indirectly associated with swine.

Instances of B. c o l i infection have been also reported in wild ruminants, such as deer(b), and animals in captivity including primates [8,11,12], zebu[33], camel, and even ostrich[27].

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Author' s address : Prof. Dr. Basil C. Hatziolos, Veterinary Science Department, University of Maryland, College of Agriculture, College Park. Md. 20740, U.S.A.

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a. Biswal, G. and Kanugo, K. (1959), mentioned by Patnaik, B.

b. Serryrier and Rousseau, mentioned by Neuveu—Lemaire.

The purpose of this paper is to describe a case of a heifer which harbored a ciliate resembling B a l a n t i d i u m c o l i in the respiratory tract and suffered from a peripharyngeal abscess complicated by bronchopneumonia. This case is the first such instance of Balantidium infestation to be reported.

CASE REPORT

The affected animal was a 2—year old Holstein—Friesian heifer belonging to a herd of 125 animals about the same age. These animals were purchased from various places for meat production. Another heifer, from the same herd, had died of pneumonia with abscess formation three weeks previously. Necropsy of the latter, which had been found dead in the field, was incomplete because of advanced decomposition.

Necropsy of the present case was performed approximately 8 hours after death. The general appearance and physical condition were good. The lung had undergone extensive hepatization in the frontal and cardiac lobes. There was diffuse interlobular edema in the remaining lobes. The pleura was thickened, hemorrhagic, and had fibrin deposits. The visceral layer adhered to the parietal pleura in many areas. Noticeable amounts of food particles were found in the medium—sized bronchi in the frontal lobes (aspiration pneumonia). The trachea, larynx, and nasal cavity were congested and had few petechia.

The pharynx was red, edematous, and covered with mucopurulent material. An ovate abscess, approximately 6×4 cm., with abundant yellowish semifluid pus was present in the suprapharyngeal lymph node area.

The heart had petechia on the epicardium and a few ecchymoses on the endocardium. The abomasum was red and the intestine, extremely congested. Petechiation was noted in the duodenum. The mucosa of the jejunum and of most of the ileum was reddened. The intestinal content was thick and yellow. Small encapsulated nodules were present in the intestinal walls. The Peyer' s patches, as well as the other lymph nodes, were enlarged. The colon and cecum had scattered, red, well—delineated, round spots, 1—2 mm. in diameter, in the submucosa and tunica muscularis. The mesenteric, as well as the mediastinal lymph nodes were enlarged and had hemorrhagic spots in the cortex; the cut surface oozed yellowish fluid.

The liver was congested and had dark red areas on the surface. The kidney was congested and discolored. The brain was firm and yellowish, but the meninges were intensely congested.

HISTOPATHOLOGY

Degenerated eosinophilic material was collected in the suprapharyngeal abscess. Fibrous stroma with hemorrhagic pockets, round cell infiltration, mostly lymphocytes and plasmacytes, and fibroblasts surrounded by adipose tissue formed the walls. There were also some bundles of muscular fibers and interstitial edema. Colonies of cocci were numerous on the edges of the purulent material. One compressed and deformed body, resembling balantidium, was noted attached to the hemorrhagic walls. The pharyngeal mucosa was infiltrated and had nests of balantidia in the submucosa (figure 1). The laryngeal and tracheal mucosae were congested and had numerous balantidia burrowed in the submucosa, and some free in hemorrhagic exudates. Eosinophilic and chronic inflammatory cells were present in the surrounding area. Moderate fibrosis was noted in the stroma.

The lung showed interlobular and alveolar hemorrhages, lobar bronchopneumonia with eosinophilic infiltration in the alveoli, and eosinophilic plugs filling the bronchial tree. Some of the bronchi of the anterior lobes contained food particles. In the remaining areas numerous balantidia were in the mucopurulent material filling most of the bronchi and bronchioli (figure 2 & 3). One balantidium was attached to the bronchial mucosa, the epithelium of which was sloughed and covered with muco—fibrinous exudate. Also, scattered balantidia, surrounded by cellular reaction, were lodged in the alveoli. Generally, in the lung, the number of invading balantidia varied from 2—3 in a high dry field to about 30 in a tissue section of 1 cm^2. Hyperplastic peribronchial lymphoid follicles often compressed the bronchi. Peribronchial, perivascular, and interlobular fibrosis was extensive. Areas of interstitial pneumonia and alveolar collapse were scattered throughout. There was also some alveolar edema. Scattered compensatory dilatation of the alveoli was noted. Special staining revealed colonies of cocci and Gram—positive slender, bent, rods.

The pleurae were thickened, hemorrhagic, and infiltrated by granulocytes. Small amounts of fibrin deposits and fibroblasts on the surface represented remnants of ruptured adhesions.

The cortex of the mediastinal lymph nodes was wide and had hemorrhages, which sometimes extended into the numerous germinal centers. The sinuses were infiltrated mostly by neutrophils. Interstitial edema was prominent.

The heart had scattered minute hemorrhages and sarcosporidia cysts throughout the parenchyma. Noted in the liver were centrilobular hemorrhages, scattered foci of leukocytic infiltration, and periportal fibrosis. The kid-

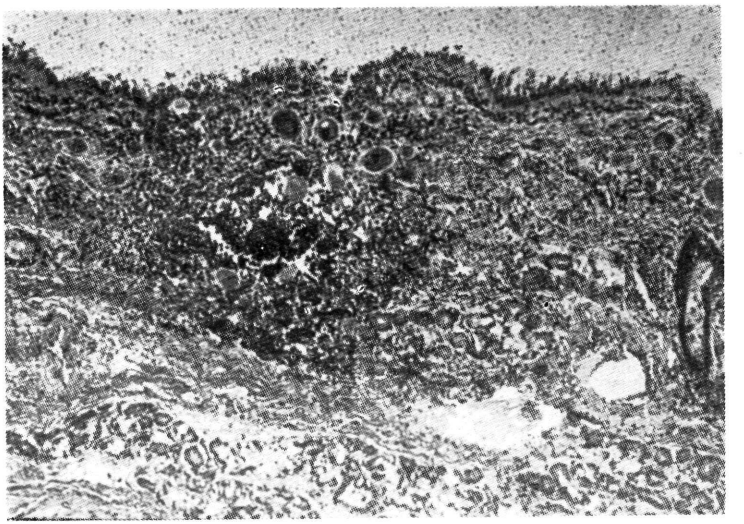


Fig. 1. Pharyngeal area. Note presence of nests of balantidia among aggregates of lymphoid cells in submucosa. H & E × 25.

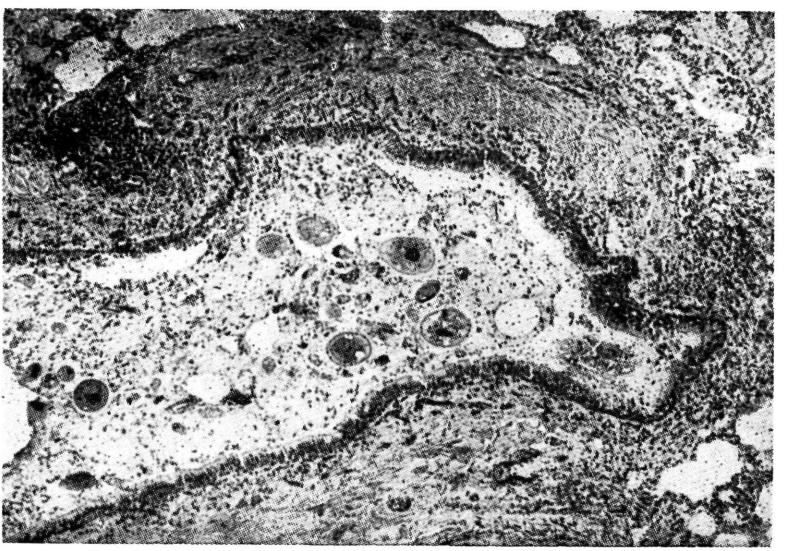


Fig. 2. Balantidia surrounded by mucopurulent material in lumen of large bronchus. H & E × 120.

ney had cortical hemorrhages and cloudy swelling in the epithelium of the convoluted tubules. In the spleen were noted partial lymphocytic depletion of malpighian bodies, reduced red pulp, parenchyma infiltrated by leukocytes, and noticeable amounts of hemosiderin.

In the small intestine, mild changes due to a few worms of the S t r o n g y l o i d e s and O e s o p h a g o s t o m u m sp. were noted, as was a balantidium on the tip of a villus. The large intestine had a few microabscesses containing degenerated eosinophils in the submucosa and tunica muscularis. However, parasitic bodies were absent.

The brain was congested and had occasional perivascular hemorrhages. There was no inflammatory reaction. One balantidium was found in the subarachnoid space of the cerebellum (figure 4).

Cultures of organs were negative for pathogens except for a streptococcus isolated from lung and liver. Cultures from the pus of the abscess showed a pleiomorphic Gram—positive organism of the Corynebacterium type. However, biochemical tests failed to characterize the reaction of this species. Isolation attempts for IBR virus were negative.

Morphologic characteristics : The balantidium in the respiratory tract was round or oval and occasionally only slightly bilobed or trilobed, depending on the number and size of the vacuoles present. The anterior end was well—developed, frequently protruding and terminating in an elongated sharp point.

The pellicle was thick, prominent, and completely covered with fine, small, closely set cilia. They were arranged in parallel, uniform rows, approximately 3μ long. Large empty vacuoles, probably contractile ones, and small food vacuoles with solid food particles and occasionally erythrocytes were present in the body. One balantidium contained 2 eosinophils. The meganucleus was round or sausage—shaped and conspicuous.

Measurements of parasites showed variations in size in the different parts of the respiratory tract (Table I). The parasitic body was smaller in those tissues in which expansion was difficult. The reconstituted body size, under normal conditions (fresh material) should measure a little over 114.0 μ long by 100.8 μ wide. These organisms were therefore slightly smaller than those found in Indian cattle[13], but a little wider than B. c o l i observed by others[27,44]. They also differed completely from the ciliate infusoria of ruminants[19]. Morphologically, these ciliates qualify for classification in the genus Balantidium.

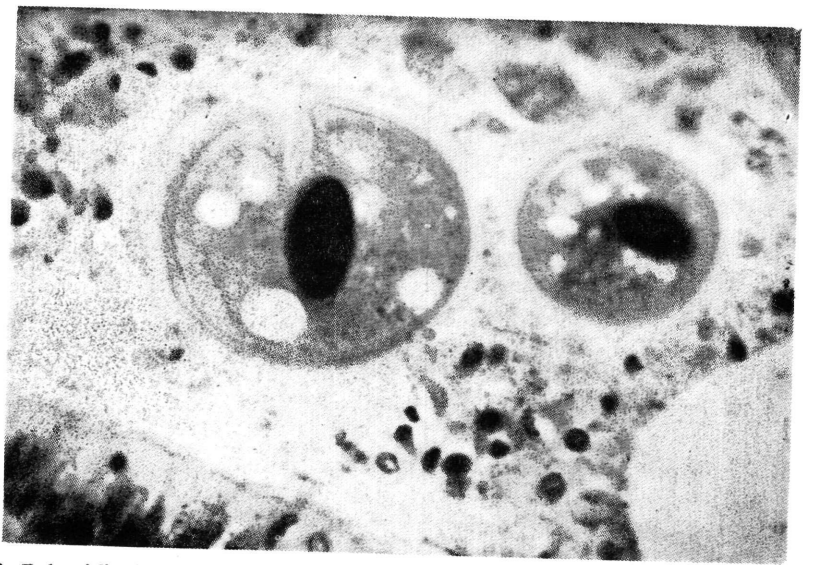
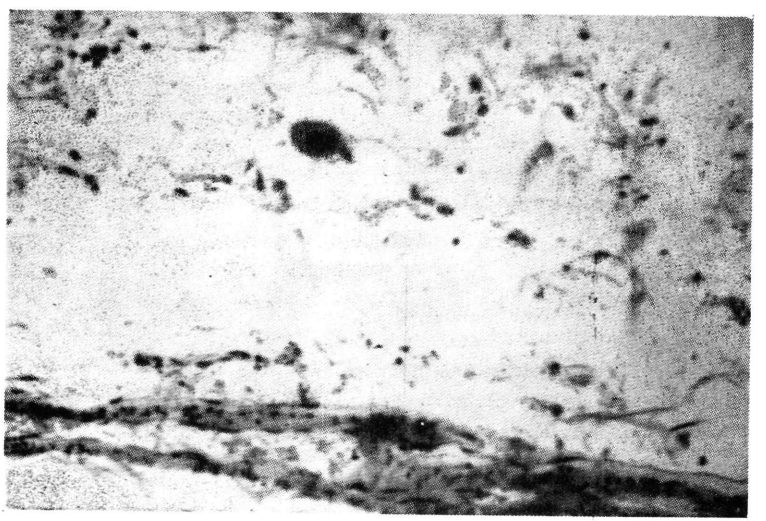


Fig. 3. Balantidia in bronchus (higher magnification). Note conspicuous peristome of larger one. H & E × 400.



F.g. 4. Banatidium in sub—arachnoid space of cerebellum. H & E × 120.

TABLE I. Minimum—maximum and mean values of balantidium body measurements in sections of various parts of the respiratory tract.

Section of Organ	Length in μ		Width in μ		
	Minimum-maximum	M ± m	Minimum-maximum	M ± m	n
Pharyngeal Mucosa	20.2—44.8	35.000 ± 0.625	15.0—36.4	25.625 ± 0.523	16
Tracheal Mucosa	25.2—72.8	44.993 ± 0.351	22.4—52.8	31.769 ± 0.225	130
Bronchi & Alveoli	19.8—114.0	58.906 ± 1.066	16.2—100.8	45.781 ± 0.894	64

M ± m = Mean & standard error of the mean.

DISCUSSION

Knowledge regarding the incidence and pathogenic potential of Balantidium species in cattle of the U.S.A. is fragmentary and scarce. The incidence of balantidiosis has been reported for a variety of domestic animals and zoo animals[24,26,27] in the State of Maryland and, therefore, it is possible that the environmental conditions of the area favor the development of these protozoa.

Although the pathogenic role is not proven in this case, because of complications due to other bacterial agents, the presence of balantidium in the tissues suggests its potential pathogenicity under certain conditions.

The abscess in the pharyngeal area could have been caused by the trauma of ingesting foreign bodies and subsequent infection. Dysphagia producedby mechanical hinderance and pain resulting from the abscess may explain the aspiration pneumonia, which could have occured a few days before death. Some ciliated organisms may have entered the respiratory tract, if they were in the stomach, via regurgitation and aspiration. Since no balantidia or other ciliated protozoa were found in the rumen or abomasum, a direct entrance of the organism into the respiratory tree from the drinking water or other source is suggested.

However, the presence of nests of this ciliate organism in the tissues, and the surrounding cellular reaction which developed in the pharyngeal laryngeal, and tracheal submucosa, indicates a burrowing and migrating capability of this protozoon. This capability could be similar to that observed for B. s u i s in the submucosa, tunica muscularis and lymphoid follicles of the intestinal tract noted in man[6,7,23,30,47,48], experimental animals[43,48]

and in pigs[2,24,31,41,45]. In the latter, Balantidia were even found in the uterus[15,28]

In addition, the penetration of B. coli in the walls of blood vessels and lymphatics of intestinal walls of the host has been reported on many occasions[3,6,23,30,47,48]. Such penetration could bring this organism into the general circulation, and, like an embolus, be transported to every part of the body. This may explain the presence of Balantidium as an erratic form in the kidney[34] and ureterine walls[35] and probably in the liver[36,46] and lung(a).

On other occasions rupture of the large intestine and presence of Balantidium in the peritoneal cavity has been recorded[6,49] in man. The possibility of division and multiplication of Balantidium in the tissue has also been suspected[3,7,23,38].

The presence of erythrocytes in the vacuoles of balantidium is a sign of aggressiveness and pathogenicity to the host[3,23,48]. Thus, a pathogenic role of this protozoon in the present case is highly probable.

The possibility that this ciliate belonged to the genus Buxtonella var. sulcata[32] is remote because of the abscence of the characteristic curved groove running from the anterior to the posterior end[28,31] in the observed ciliates.

Whether we are dealing in this case with a new species of ciliate or whether this is B. coli var. bovis[13,26] or an erratic case of Balantidium suis are questions that cannot be answered with certainty at present. Comprehensive research is required to differentiate the various species of these organisms and determine the extent of their pathogenicity in cattle.

SUMMARY

Ciliate organisms, resembling Balantidium coli, were found in the pharynx and respiratory tree of a 2—year old Friesian—Holstein heifer suffering from a peripharyngeal abscess, focal aspiration pneumonia, and bronchopneumonia. Despite a noticeable bacterial infection, the presence of these protozoa in the laryngeal, tracheal, and pharyngeal submucosa, in the bronchi, and in the alveoli producing focal cellular response was suggestive of a penetrating capability of the parasite, without excluding its probable transportation through blood circulation. Some of the morphological characteristics of this protozoon are included.

a) Winogradow, mentioned by M. Neveu—Lemaire and W. Klimenko.

ΒΑΛΑΝΤΙΔΙΟΝ ΕΙΣ ΤΟ ΑΝΑΠΝΕΥΣΤΙΚΟΝ ΣΥΣΤΗΜΑ ΒΟΟΕΙΔΟΥΣ**

Ὑπὸ

Β. Κ. ΧΑΤΖΗΟΛΟΥ

ΠΕΡΙΛΗΨΙΣ

Βλεφαριδοφόροι ὀργανισμοί, προσομοιάζοντες τὸ Balantidium Coli, ἀνευρέθησαν εἰς τὸν φάρυγγα καὶ τὸ ἀναπνευστικὸν δένδρον δαμάλεως φυλῆς Friesian—Holstein ἡλικίας 2 ἐτῶν. Τὸ ζῶον ἔπασχεν ἐκ περιφαρυγγικοῦ ἀποστήματος, ἑστιακῆς πνευμονίας ἐξ ἀναρροφήσεως καὶ βρογχοπνευμονίας. Παρὰ τὴν παρατηρηθεῖσαν μικροβιακὴν μόλυνσιν, ἡ παρουσία τῶν πρωτοζώων τούτων ἐντὸς τοῦ ὑποβλεννογόνου τοῦ λάρυγγος, τῆς τραχείας καὶ τοῦ φάρυγγος ὡς ἐπίσης εἰς τοὺς βρόγχους καὶ τὰς πνευμονικὰς κυψελίδας, τὰ ὁποῖα προεκάλεσαν ἑστιακὴν κυτταρικὴν ἀντίδρασιν, ὑποδηλοῦν τὴν ἱκανότητα εἰσχωρήσεως τοῦ παρασίτου, μὴ ἀποκλειομένης τῆς πιθανῆς διὰ τοῦ αἵματος μεταφορᾶς του.

Εἰς τὴν μελέτην περιλαμβάνονται καί τινα μορφολογικὰ χαρακτηριστικὰ τοῦ πρωτοζώου τούτου.

REFERENCES

1. ABRAHAM, R. (1962) : The description of three new species of Balantidium from Indian mammals. Arch. Protistenk. **106** : 41—50.
2. ALMEJEW, CH. (1963) : Zur Frage der Ausbreitung von Balantidium in Darm der Schwine. Mh. Vet. Med. **18** : 250.
3. ASKANAZY, M. (1902) : Über die pathogene Bedeutung des Balantidium coli. Verhandlungen Dt. Path. Ges., Berlin. **5** : 244—233.
4. BAILEY, W. S. and A. G. WILLIAMS (1949) : Balantidium infection in the dog. J. Am. vet. med. Ass. **114** : 238.
5. BEHERA, K. L. (1967) : Treatment of balantidiosis in cattle and buffaloes with iquor Arsenicalis. Indian vet. J. **44** : 1080—1081.
6. BOWMAN, F. B. (1909) : Two cases of Balantidium coli infection with autopsy. Philipp. J. Sci. (B. Med. Sci.), Manilla. **4** : 417—423.
7. BOWMAN, F. B. (1911): The pathogenesis of the Balantidium coli. J. Aml med. Ass. **57** : 1814—1817.
8. BROOKS, H. (1902) : Contribution concerning the pathogenesis of the Balantidium coli. N. Y. Univ. Bull. med. Sci. **2** : 1—17.
9. BUISSON, J. (1923) : Les infusoires ciliés du tube digestif de l' homme et des mamm-i fères. Thése de Mêdecine, Paris.
10. CAVYENKO, V. F. (1969) : Morphological and biochemical changes in the blood in balantidium in sheep. Veterinariya. **46**, (No. 1) : 50—51.
11. CHRISTELLER, E. (1922) : Die Balantidien—Ruhr bei den Schimpansen des Berliner Zoologischen Gardens. Virchows Arch. path. Anat. Physiol. **238** : 396—422.
12. COCKBURN, T. A. (1948) : Balzntidium infection associated with diarrhea in primates. Trans. R. Soc. trop. Med. and Hyg. **42** : 291—293.
13. COOPER, H. and A. GULATI (1926) : On the occurrence of Isospora and Ba-

l a n t i d i u m in cattle. Mem. Dep. Agric. India, vet. Ser. Agr. Res. Inst. Pusa. **3** : 191—193.

14. CUNHA, (da), A. (1917) : Sobre a presenca do Balantidium no cavallo. Bras.—méd· **3** (N. 40) : 337.
15. DA SILVA LEITAO, J. L. (1962) : Parasita riferidos em Portugal metropolitano por médicos—veterinàrios portuguèses. Anais. Esc. Sup. Med. vet. Lisb. **4** : 5—50.
16. DAVID, A. and M. C. JOHN (1966) : Efficacy of Dequinol in the treatment oj bovine balantidiasis. Indian vet. J. **43** (3) : 269—270.
17. DEWES, H. F. (1959) : An occurrence of B a l a n t i d i u m c o l i in calves. N. Z. vet. J. **7** : 42.
18. DICKMANS, F. (1948): The dog, C a n i s f a m i l i a r i s, a new host of Balantidium sp. Proc. helminth. Soc., Wash. **15** : 40.
19. EBERLEIN, R. (1895) : Ueber die im Wiederkäuremagen vorkommenden ciliaten Infusorien. Z. wiss. Zool. **59** : 233—304.
20. EWING, S. A. and R. W. BULL. (1966) : Severe chronic canine diarrhea associated with balantidium—trichuris infection. J. Am. vet. med. Ass. **149** : 519—520.
21. GREEN, J. E. and R. E. THORSON (1954) : Canine intestinal protozoa as related to enteritis .4th Gaines Vet. Sympos., Oct. 20, Kankakee, Ill. 6—9.
22. HAGAN, W. A. and D. W. BRUNER (1947) : The infectious diseases of domestic animals. Comstock Publ. Co. Inc., Ithaca, New York.
23. HARMS, H. (1932) : Beitrag zur Histopathologie der Balantidiencolitis. Virchows Arch. path. Anat. Physiol. **284** : 422—437.
24. HATZIOLOS, B. C. (1972) : Pathogenicity of B a l a n t i d i u m c o l i in porcine species as evidenced by histopathologic lesions. Proc. IInd. Intern. Congress of I. P. V. A., Hannover (Germany), May 23—26, 1972. V. **1** : 74.
25. HAYES, F. A. and H. E. JORDAN (1956) : Canine helminthiasis, complicated with balantidium species. J. Am. vet. med. Ass. **129** : 161.
26. HEGNER, R. W. (1924) : Giardia and chilomastix from monkeys, and giardia from the wild cat, and balantidium from the sheep. J Parasit. **11** : 75—78.
27. HEGNER, R. W. (1934) : Specificity in the genus balantidium based on size and shape of body and macronucleus, with description of six new species. Am. J. Hyg. **19** : 39—67.
28. INGLES, ABOIM A. e J. L. DA SILVA LEITAO (1942) : Caso de intestacao do utero duma porca por B a l a n t i d i u m c o l i (Um.) Bolm. pecuàr. **10** : 105.
29. JAMESON, A. P. : A ciliate «B u x t o n e l l a s u l c a t a N. G., N. S. P.», from the coecum of cattle. Parasitology **18** : 182—186.
30. KLIMENKO, W. (1903) : Beitrag zur Pathologie des B a l a n t i d i u m (P a r a m e c i u m) c o l i. Beitr. path. Anat. **33** : 281—301.
31. KOZAR, Z. (1961) : Mechanisms of invasion and parasite migrations in the body of the host. Wiad. parazyt. **7** : 541—559.
32. LAPAGE, G. (1968) : Veterinary Parasitology. 2nd Ed. Oliver and Boyd Publ. Edenb.—London.
33. LEVINE, N. D. (1961) : Protozoan pzrasites of domestic animals and of man. Minneapolis : Burgess Publishing Co.
34. LLIROD, R. J. R. (1960) : Traumatismo renal en un gran rinon hidronefrotico con

Schistosomum hoematobium y Balantidium coli. Revta. argent Urol. **20** : 7—10.

35. MALIWA, E. u V. VON HAUS (1920) : Über Balantidieninfektion der Harnwege. Z Urol. **14** : 495—501.
36. MANSON, P. (1908) : Liver abscess preceded by dysentery. J. trop. Med. Hyg. London. **11** : 258.
37. NARDI, E. (1960) : La balantidiosi nei suini e nei bovini del comune di Foggia. Veterinaria ital. **11** : 868—873.
38. NEVEU—LEMAIRE, M. (1943) : Traité de Protozoologie Médicale et Vétérinaire, Vigot Fr. Paris.
39. NORGARIN, S. (1957) : La Balantidiosi nei bovini. Veterinaria, Milano. **6** : 201—202.
40. PATNAIK, B. (1965) : Clinical symptoms and treatment of balantidium infection in cattle and buffaloes. Indian vet. ;J. **42** : 624—632.
41. PRITZE, F. (1928) : Beiträge zur Kenntnis des Balantidium coli. Z. Parasitkde. **1** : 345—415.
42. PRIESTLEY, F. W. (1944) : Balantidium infection in a buffalo. Jl. R. Army vet. Cps. **16** : 129.
43. RATCLIFFE, H. L. (1934) : Intestinal lesions associated with amebic and balantidial infection in man and lower animals. Am. J. Hyg. **19** : 68—85.
44. SARGEANT, P. G. (1971) : The size range of Balantidium coli. Trans. R. Soc. trop. Med. Hyg. **65** : 428.
45. SHCHENNIKOV, S. T., A.V. ORLOVA and M. L. BUJNIZKAYA (1939) : On the question of dysentery of swine. Sov. Vet. **16** (6) : 22—24.
46. STOKVIS, B. J. (1884) : Paramaecium in Sputa. Weelblad van. h. Nederl. Tijdschr. v. Geneesk. Amst. **20** : 4.
47. STRONG, R. P. (1904) : The clinical and pathological significance of Balantidium coli. Philipp. Islands : Publ. Publ. Bureau Govern. Lab. No. **26** : 1—77. B.P.P. Manilla.
48. WALKER, E. L. (1913) : Experimental Balantidium coli. Philipp. J. Sci. (Sec. B) **8** : 333—347.
49. ZAV'IALOWA, M. F. (1962) : Balantidial colitis complicated by perforation of the intestinal wall. Medskaya Parazit. **31** (5) : 571—572.