***Parabundleia ruminantium* gen. n., sp. n., *Diplodinium mahidoli* sp. n. with Two Formae, and *Entodinium parvum* forma *monospinosum* forma n. from the Zebu Cattle (*Bos indicus* L., 1758) in Thailand**

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ABSTRACT. In the survey conducted on 10 zebu cattle, *Bos indicus* L., 1758, in Thailand to make clear the geographical distribution of rumen ciliates, one new genus and one new species belonging to Buetschliidae, one new species of *Diplodinium*, and one new forma of *Entodinium parvum* were recognized. They were described as *Parabundleia ruminantium* gen. n., sp. n., *Diplodinium mahidoli* sp. n., and *Entodinium parvum* forma *monospinosum* forma n., respectively. *P. ruminantium* is elliptical in shape and 37–50 μm in length, and has two anterior and one posterior ciliary zones. The two anterior ciliary zones are situated around the cytostome and near the concretion vacuole, and the posterior one occupies very narrow area besides the cytoproct. *D. mahidoli* is one of the largest diplodinia, 117.5–167.5 μm long, and has broad ectoplasm and two caudal processes. Of these processes, the right one forms a spine but the left one a lobe or a spine. So that this species was classified into two formae on the basis of the shape of the left caudal process, namely, *D. mahidoli* forma *mahidoli* with a lobe and *D. mahidoli* forma *bispinosum* with a spine. *E. parvum* forma *monospinosum* is elongated-ellipsoidal in shape with one spine at the left posterior extremity of body. The body is 35–45 μm long. The morphological characters of this ciliate were the same as those of *E. parvum* Buisson, 1923, except the possession of a caudal spine, so that this ciliate was assigned in this paper to one forma of the species.

Zebu cattle is one of the most popular domestic animals around the tropical and semi-tropical areas as well as water buffalo. Then rumen ciliate composition has been surveyed on the zebu cattle in India and Sri Lanka by Kofoed and MacLennan [5–7]. In their papers, 109 species of rumen ciliates including many new species were described.

Previously, we surveyed the rumen ciliate composition of the water buffalo in Taiwan for the purpose to make clear the geographical distribution of rumen ciliates of ruminants in Southeast Asia, and described 4 new species [4]. Continuously, we studied on the ciliate composition of the zebu cattle in Thailand and ob-

tained one new genus and one new species belonging to Buetschliidae, and one new species and one new forma belonging to Ophryoscolecidae, so that these are described in this paper as *Parabundleia ruminantium* gen. n., sp. n., *Diplodinium mahidoli* sp. n., and *Entodinium parvum* forma *monospinosum* forma n., respectively.

MATERIALS AND METHODS

Samples of rumen content were collected from 10 adult zebu cattle, *Bos indicus* L., 1758, within 1 hr after having been slaughtered at the abattoirs in Bangkok, Thailand in December, 1979. The host cattle had been fed continuous-

ly on the true grasses. Twenty-milliliters of rumen content was collected from each animal and fixed with 40 ml of MFS solution [8] or 10% (V/V) formalin solution for temporary preparations. A part of each sample was stained with Mayer's hematoxylin for whole mount.

The terminology used for describing the structure and orientation of the ciliates was conformed to that by Ogimoto and Imai [8].

Measurement of the ciliates was made by an ocular micrometer. Mean body length and width were calculated from the measurement of 20 individuals selected at random.

RESULTS AND DISCUSSION

Of the ciliates obtained in the present examination, one genus and one species, one species with two formae, and one forma were new to science as follows.

Family Buetschliidae

Parabundleia gen. n.

Diagnosis: Body ovoid. Three ciliary zones, two anterior zones around cytostome and near concretion vacuole, and one posterior zone occupying the narrow area beside cytoproct. A macronucleus elliptical and situated at the central part of body. A micronucleus spherical and situated near the anterior margin of macronucleus. One contractile vacuole at the posterior part and one concretion vacuole at the anterior part of body.

Type species: *Parabundleia ruminantium* sp. n., the only one species of the genus.

Parabundleia ruminantium gen. n., sp. n.
(Figs. 1, 4, 5)

Diagnosis: With characters of the genus.

Description: Body is generally ovoid, but the outer surface is slightly elevated

Fig. 1. *Parabundleia ruminantium* gen. n., sp. n.

at the anterior extremity of body and near concretion vacuole. Uniform cilia arise on the three ciliary zones; the largest zone around cytostome, the middle zone near concretion vacuole, and the smallest zone which has only five or six cilia beside cytoproct at the posterior extremity of body. A macronucleus is elliptical, 15.8 μm in average length, and usually situated at the central part of body, but sometimes in various parts of endoplasm. A spherical micronucleus is situated near the anterior margin of macronucleus. A contractile vacuole is usually found at the posterior end of body. A spherical concretion vacuole is situated near the anterior extremity of body, including about ten granules in it.

Dimension:

	Mean	S.D.	Range
Length	42.5 μm	4.2 μm	37.5–50.0 μm
Width	30.5 μm	1.9 μm	27.5–32.5 μm
L/W	1.39	0.10	1.25–1.54

Type host and locality: Zebu cattle, *Bos indicus*, in Bangkok, Thailand.

Habitat: Rumen.

Incidence: *P. ruminantium* was detect-

ed in 40.0% of the zebu cattle surveyed.

REMARKS: *Parabundleia ruminantium* is similar to *Buetschlia parva* Schuberg, 1888 [9] in shape. However, *P. ruminantium* has only three ciliary zones on body surface, whereas *B. parva* has uniform somatic cilia all over the body surface in addition to the long cilia surrounding cytostome. In the ciliary pattern, the present new species resembles *Bundleia postciliata* (Bundle, 1895) Cunha et Munitz, 1928 [2], which is found in the large intestine of horse. *B. postciliata*, however, has the ciliary zones confined to two areas, peristome and the posterior extremity of body, and no ciliary zone on the body surface near concretion vacuole. In addition, the ciliates belonging to the genus *Bundleia* differ from those of the genus *Parabundleia* in the habitat; i.e. the former is detected only from the large intestine of horse [10].

Family Ophryoscolecidae

Diplodinium mahidoli sp. n.

(Figs. 2, 8–12)

Diagnosis: Body ovoid, 117.5–167.5 × 77.5–112.5 μm in size and the ratio of length to width, 1.49. Two caudal processes composed of the right one forming a spine and the left one a spine or a lobe. Ectoplasm broad laterally and hyaline.

Description: Body is ovoid but flat above and below, with relatively large two caudal processes. Ectoplasm is extremely prominent, being expanded on both sides, especially remarkable on the left side and on the posterior right side of body. Many fine granular structures are included in ectoplasm. The posterior extremity of body forms two heavy processes, the right one of which forms a spine, and the left one of which a spine or a lobe. In any case, the shape and the size of them are rather variable, especially the caudal spine varies from barely visual one to conspicuous large one. There is a prominent operculum at the anterior end of body. Endoplasm is fairly thick, so that the structures contained in it are hardly observed in general. Cy-

Fig. 2. *Diplodinium mahidoli* sp. n. A: *D. mahidoli* forma *mahidoli* forma n. Upper side view; B: *D. mahidoli* forma *bispinosum* forma n. Lower side view.

toproct is relatively wide and opens between two caudal processes. Macronucleus is rod-shaped but it bends rightward in the anterior third, as well as in other species of the genus *Diplodinium*. A small elliptical micronucleus is situated on the outer side of the bending part of macronucleus. Two elliptical contractile vacuoles are situated tandem in ectoplasm at the left side of macronucleus. Anterior contractile vacuole is situated at the same level as that of micronucleus and the posterior one at the middle of body.

Dimension:

	Mean	S.D.	Range
Length	138.7 μm	11.9 μm	117.5 – 167.5 μm
Width	93.5 μm	10.4 μm	77.5 – 112.5 μm
L/W	1.49	0.11	1.25– 1.72

Type host and locality: Zebu cattle, *Bos indicus*, in Bangkok, Thailand.

Habitat: Rumen.

Incidence: *D. mahidoli* was detected in 40.0% of the zebu cattle surveyed.

REMARKS: Genus *Diplodinium* is a rather small size group in Diplodiniinae and few of the species are over 120 μm in body length. Of the member of the genus, *Diplodinium psittaceum* Dogiel, 1927 [3] resembles the present species. It is, however, distinguished from *D. psittaceum* by the following points: (1) the broad ectoplasm on both sides, (2) an elongated and relatively slender macronucleus, (3) without a narrow rib arising from the posterior half on the right side of the median line of body, and (4) the situation of posterior contractile vacuole which lies in the posterior half of body. In addition, though the shape of the thin right spine of *D. psittaceum* has been reported to be relatively stable character [6], the caudal spine of the present spe-

cies shows wide variation in a striking contrast to the above.

Diplodinium mahidoli is divided into following two formae on the basis of the shape of left caudal process.

Diplodinium mahidoli forma *mahidoli*
forma n.

(Figs. 2-A, 8, 9)

Diagnosis: The left caudal process forms a lobe.

Incidence: This form was detected in 30.0% of the zebu cattle surveyed.

Diplodinium mahidoli forma *bispinosum*
forma n.

(Figs. 2-B, 10–12)

Diagnosis: The left caudal process forms a spine with wide variation in size and shape.

Incidence: This form was detected in 30.0% of the zebu cattle surveyed.

Entodinium parvum Buisson, 1923
forma *monospinosum* forma n.

(Figs. 3, 6, 7)

Diagnosis: With characters of *E. parvum* Buisson, 1923, except caudal spine. Body elongated-ellipsoidal. A macronu-

Fig. 3. *Entodinium parvum* forma *monospinosum* forma n. Lower side view.

cleus long and rod-shaped, and located close to right body surface. One caudal spine at the left posterior extremity of body.

Description: Body is elongated-ellipsoidal, and almost symmetrical in view from the upper or lower side. The anterior end of body is even or slightly concave and the posterior end of body is rounded. There is a relatively heavy caudal spine at the left posterior extremity of body. Some variations are recognized on the size and the shape of the spine. Macronucleus is rod-shaped, and over two-thirds of body in length, and is situated close to the right surface of body. A small elliptical micronucleus lies on around the anterior third of macronucleus. A contractile vacuole is situated above macronucleus near the anterior extremity.

Dimensions:

	Mean	S.D.	Range
Length	38.0 μm	3.1 μm	35.0–45.0 μm
Width	17.2 μm	1.1 μm	15.0–18.8 μm
L/W	2.22	0.17	1.99–2.57

Type host and locality: Zebu cattle, *Bos indicus*, in Bangkok, Thailand.

Habitat: Rumen.

Incidence: *E. parvum* forma *monospinosum* was detected in 60.0% of the zebu cattle surveyed.

REMARKS: This form is closely related to *Entodinium rostratum* Fiorentini, 1889 in the presence of one left caudal spine [3]. The other morphological characters of this form are, however, the same as those of *Entodinium parvum* Buisson, 1923 [1], except caudal spine. It is distinguished from *E. rostratum* by the following points; (1) shape of body, especially of its anterior extremity, (2) body length, and (3) shape and size of macronucleus.

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EXPLANATION OF FIGURES

All the light photomicrographs show the new rumen ciliates fixed in MFS solution.

Figs. 4 and 5. *Parabundleia ruminantium* gen. n., sp. n.

Fig. 4: A concretion vacuole and a macronucleus are shown. $\times 590$. Fig. 5: A contractile vacuole at the right posterior end of body. $\times 590$.

Figs. 6 and 7. *Entodinium parvum* forma *monospinosum* forma n.

Fig. 6: Lower side view. $\times 530$. Fig. 7: Up-

per side view. $\times 530$.

Figs. 8–12. *Diplodinium mahidoli* sp. n.

Figs. 8 and 9: *D. mahidoli* forma *mahidoli* forma n. Lower side view. Each left caudal process forms a lobe. Both the figures are $\times 400$. Figs.

10–12: *D. mahidoli* forma *bispinosum* forma n. Each left caudal process forms a spine. The spine has wide variations in shape. Fig. 10: Lower

side view. $\times 400$. Fig. 11: Upper side view. $\times 330$. Fig. 12: Upper side view. $\times 330$.

要 約

タイ産コブウシ (*Bos indicus* L., 1758) から見出された *Parabundleia ruminantium* gen. n., sp. n., *Diplodinium mahidoli* sp. n. および *Entodinium parvum* forma *monospinosum* forma n. の記載: 今井壯一・扇元敬司¹⁾ (日本獣医畜産大学寄生虫学教室, ¹⁾ 東北大学農学部家畜衛生学教室)——タイ産コブウシ10頭から得たルーメン内容中の繊毛虫の種類構成について調査し, プチリア科の1新属新種, オフリオスコレックス科 *Diplodinium* 属の1新種, および *Entodinium* 属の1新型を認め, それぞれ *Parabundleia ruminantium*, *Diplodinium mahidoli*, *Entodinium parvum* forma *monospinosum* として記載した. *P. ruminantium* は楕円形を呈し, 体長 37–50 μm , 頭部2箇所, 尾部1箇所に繊毛帯を有していた. 頭部のものは囁口部と凝結胞周辺の外皮に存在し, 尾部のものは細胞肛門付近にわずか5–6本の繊毛束として存在した. *D. mahidoli* は大型の *Diplodinium* で体長 117.5–167.5 μm , 幅広い外質と体後端に2本の突起をもち, このうち体右側のものは棘を形成していたが, 左側のものは葉状突起のものと棘を形成するものとがあり, それぞれ *D. mahidoli* forma *mahidoli* forma n., *D. mahidoli* forma *bispinosum* forma n. と命名した. *E. parvum* forma *monospinosum* は体長 35–45 μm , 長楕円形の体をもち, 体後端左側に1本の尾棘を有していたが, 尾棘の有無以外の形質は *E. parvum* Buisson, 1923 と一致したので, 本種の1型として報告した.