

IV. CILIATES OF THE STOMACH OF THE SHEEP

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The material used was obtained from the U. M. Slater Stockyards, Oakland, California, and killed in hot Schaudinn's Solution. Iron alum haematoxylin was the most satisfactory stain for whole mounts and sections. Altogether 39 samples were taken from August, 1925, to June, 1926. They were studied in the zoological laboratory at the University of California.

In the rumen and reticulum of sheep are found many ciliates, which live in the neutral or slightly alkaline fluids contained in them. The reticulum can be easily emptied of its bulky content and the secretion together with the finer debris and organisms collected in warm vessels for examination and fixation. Probably 5 per cent of content thus collected consists of ciliates. These organisms belong to the Family Isotrichidae of the Order Holotricha Stein and the Family Ophryoscolecidae of the Order Oligotricha Bütschli.

In the first family there are 3 species belonging to the genus *Isotricha*.

Isotricha prostoma Stein, 1859.

The body is oval, slightly compressed dorsoventrally with the anterior extremity pointed. The mouth opens near the posterior end. The body is striated longitudinally with rows of cilia having the same direction as the striation. The pharynx is conical and gently bends to the left, the macronucleus is of almost the same form as the body, the micronucleus is small and oval, almost embedded within the dorsal side of the macronucleus. Typical specimens measure from 80 to 160 μ (microns) in length, 53 to 120 μ in width. These were found quite abundant in the sheep from California and Nevada, but less so from the Oregon sheep. They seem to feed on bacteria and perhaps small particles of hay.

Isotricha intestinalis Stein, 1858.

The species resembles the preceding species in size and shape, but has the mouth opening upon the ventral side, about $\frac{3}{4}$ of the length of the animal from the posterior end. It also stains more deeply than the preceding, and is not quite so numerous. They measure from 97 to 130 μ in length, 68 to 88 μ in width. The size of the species found in the sheep is smaller than that given for the species in cattle by Schuberg and the mouth opening is more posterior than his drawing would lead

one to believe. This may be a smaller race than that described by Schuberg, but I believe they belong to the same species.

***Isotricha (Dasytricha) ruminantium* Schuberg. 1818.**

This species was placed in a separate genus (*Dasytricha*) by Schuberg, but Dogiel, 1925, considered it as a species of the genus *Isotricha*. The absence of the nuclear supports, (Kernsteile) the presence of the anal support, the small size and presence of only one relatively large contractile vacuole easily distinguishes this species from the preceding. The macronucleus, although variable in shape and position, is usually located near the middle of the long axis with the micronucleus lying close to it on one side. Schuberg gives the size as 50-100 μ in length, 25-66 μ in width. In the sheep, they average 48 μ in length, 26 μ in width. They are rather numerous in the sheep of the Pacific coast.

In the Ophryoscolecidae there are 3 genera and 9 species found in sheep.

***Entodinium bursa* Stein. 1858.**

The body is flattened dorso-ventrally 55-114 μ in length, 37-78 μ in width. It has only the adoral membranelle zone, and one contractile vacuole. It is the most common *Entodinium* met with in sheep.

***Entodinium minimum* Schuberg. 1888.**

This species is small, 30-40 μ in length, 10 to 20 μ in width, somewhat elongated and flattened dorsoventrally. It is usually rare in sheep.

***Entodinium caudatum* Stein 1858.**

This species is similar to *E. bursa* at the anterior end, but the ventral side of the posterior end is deeply excavated, ending in one elongated projection and 2 short ones. Only one specimen of this species was identified from the samples of 39 stomachs.

***Diplodinium bursa* Stein. 1858.**

This species was the most interesting of all the ciliates found in the sheep. It was the only species that averaged larger than the averages given for the species in all ruminants. It was most frequently found in division, and usually contained *Entodinium* and other small ciliates as food, but when *Diplodinium bursa* was in great abundance, the smaller ciliates were rarely found. The general shape of the body corresponds very closely to that figured and described by Eberlein (1895), but the shape of the macronucleus, the micronucleus and the adoral membranelle is entirely misleading and inaccurate in his figures.

The size in ruminants is given as 100 -140 μ in length, 60-70 μ

in width. In the sheep they average 152μ by 72μ . From observations on the living animals, whole mounts and sections, it is very evident that the adoral membranelle is similar to that of *Diplodinium ecaudatum*, but with the mouth region, opening more anteriorly, i. e., it turns only slightly to the left. This animal retracts its membranelle zones more readily than *Diplodinium ecaudatum*. Like the latter, it moves rather rapidly and eats smaller ciliates and particles of hay.

Diplodinium magii Fiorentini. 1889.

This species is broader than *D. bursa*. It measures $180-240\mu$ in length, $120-170\mu$ in width. It has a pistol shaped macronucleus and is consistently flattened. It was rarely found when *D. bursa* was present.

Diplodinium ecaudatum Fiorentini. 1889.

Three varieties of this species were found in the sheep in relatively large numbers. In cattle they range in size from $90-137\mu$ in length and 40 to 45μ in width. In the sheep, these animals were smaller, averaging between $90-110\mu$ in length.

Ophryoscolex inermis Stein. 1858.

This species as well as the next 2, has 2 membranelle zones—the dorsal, extending about $4/5$ of the way around the body. The contractile vacuoles number from 4 to 6. It is $170-190\mu$ in length, and $65-100\mu$ in width. It has no posterior projections.

Ophryoscolex purkynjii Stein. 1858.

This species is similar to the preceding with a series of compound projections from the posterior end.

Ophryoscolex caudatus Eberlein. 1895.

This species is similar to *O. purkynjii*, with an elongated posterior spine.

All of these were found in the sheep but none abundantly. It is probable that the 3 species of *Ophryoscolex* should be considered varieties of the same species.

In addition to the fact mentioned above that *Diplodinium bursa* seemed to be better adapted to conditions in the sheep than any other species, it was found that sheep fed on alfalfa hay at night and slaughtered between 8 and 9 o'clock the next morning contained *Diplodinium bursa* actively dividing, and this is true to some extent also of *Diplodinium magii*. All stages in fission of the former species were obtained, but no conjugating pairs were found.

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