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Transmission electron microscopy of ventral sucker papillae of *Brachylaimus aequans* (Digenea: Brachylaimidae)

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Abstract. Transmission electron microscopy of *Brachylaimus aequans* (Looss, 1899) revealed papillae on both the inside and outside of ventral sucker. The papillae can be divided into 3 different types according to the internal receptor structure. All types of receptors were nonciliated and entirely intrategumental in location.

The paper is one of a series of ultrastructural studies of the tegument of this trematode. SEM and TEM results of the body tegument studies have been published by Žďárská et al. (1988a, 1990), and of the prepharynx and pharynx tegument studies by Žďárská et al. (1988b). The aim of the present study, as well as of the foregoing ones, was to elucidate morphological changes associated with the transition between developmental stages of some digenetic trematodes of terrestrial animals. The peculiarity of the life cycle of *B. aequans* is the freely moving cercaria in the terrestrial environment and the nonencysted metacercaria in the second intermeditae host, a terrestrial snail. Both larval stages have been studied by SEM by Žďárská and Soboleva (1980).

MATERIALS AND METHODS

Adult specimens of *Brachylaimus aequans* (Looss, 1899) at the age of 6–8 days, which were used in our study originated from the experiment of T. N. Soboleva of the Institute of Zoology, Academy of Sciences of Kazakhstan, Alma-Ata. They were obtained by experimental feeding of white laboratory mice with metacercariae from the snail *Macrochlamys schmidti* Brancsik, 1891. Worms isolated from the intestine were washed in saline, fixed in 3% glutaraldehyde in 0,1 M cacodylate buffer (pH 7.2) for 2 h at 4 °C, postifixed for 2 h at 4 °C in 1% OsO_4, dehydrated through an alcohol series and embedded in Durcupan via acetone. Series of ultrathin sections were cut with an LKB 8800 Ultratome III ultramicrotome, post-stained with uranyl acetate and lead citrate, and viewed in a Philips 420 electron microscope at 80 kV. Semithin sections were stained in toluidin blue.

RESULTS

Four types of nonciliate receptors (Figs. 1–7), detected in the region of the ventral sucker, were enclosed entirely by the tegument with no access to the exterior. Three types were localized on the inside and one type on the outside of the sucker.

1. Receptor with concentrated neurotubules in the apical part

This type of receptor (Figs. 1, 7 A) was localized in the papillae on the outside of the ventral sucker and contained neurotubules concentrated in the centre of the apical part. The bulbus was enforced by one electron-dense ring. Opposite this ring the neurilemma of the bulbus was connected with the plasmalemma of the tegument by a septate desmosome. Many deep tegumental invaginations occurred in the basal part of these receptors.

2. Receptor with large rootlet

This receptor (Figs. 2, 7 B) was localized in the papillae on the inside of the ventral sucker. The bulbous part contained a large rootlet with very fine cross striations, many mitochondria and electron-lucide vacuoles. Below the neurilemma there were some hemidesmosome-like structures.

3. Receptor with strongly vacuolated electron-dense cytoplasm

Receptors of this type (Figs. 3, 7 C) were localized in papillae on the inside of the sucker. The dense cytoplasm beside large vacuoles included few neurotubules. The nerve fibre, containing neurotubules and electron-lucide vacuoles, was running from the bulbous part for a long distance parallel with the tegument between the basal plasmalemma and basal lamina.

4. Disc-like receptor

This receptor (Figs. 3, 4, 6, 7 D) was detected on the inside of the sucker, and was not localized in a papilla. It was situated between the basal lamina and basal plasmalemma of the tegument in form of a flattened bulb with a single electron-dense ring. Opposite the ring a septate desmosome connected the bulb with the plasmalem-

ma of the tegument. The cytoplasm of the disc-like bulb contained neurotubules concentrated mainly in the apical part of the receptor, and few mitochondria. The nerve fibre containing neurotubules was running parallel with the tegument for a long distance before entering the basal lamina.

DISCUSSION

Relatively little is known about the receptor structure of wholly terrestrial digenetic trematodes. Available are only several scanning electron microscopic studies (Crites and Jilek 1981, Bakke 1982, Žďárská et al. 1983a, 1988b, Žďárská and Soboleva 1990).

Few data are available concerning the mode of penetration of the nerve fibres running from the receptors to the nerve trunk. It is generally accepted that the receptor nerve fibre penetrates the basal lamina directly below the receptor. In some receptors of the ventral sucker of *B. aequans* the nerve fibre does not penetrate the basal lamina immediately behind the receptor, but is running for a long distance on the base of the tegument (between basal plasmalemma and basal lamina). The tegument of both the ventral and oral suckers, and of the pharynx differs from the general body tegument (Žďárská et al. 1988b, 1990) in the presence of a lacunal system in its basal part. This lacunal system arises by attachment of the tegument by hemidesmosomes to the basal lamina at several points. This mode of attachment facilitates the contractions of the suckers. In lacunae of the basal part of the ventral sucker tegument the nerve fibres of some receptors running for a long distance parallel with the base of the tegument can be very well traced. A receptor with a nerve fibre running parallel with the tegument was depicted earlier by Edwards et al. (1977) in the oral sucker of the adult *Philophthalmus megalurus* Cort,1914. A similar parallel orientation of the nerve fibre was observed by Žďárská et al. (1983a) in the cercaria of *Eurytrema pancreaticum* Janson, 1889, in which the nerve fibre was not running in the base of the tegument, but between the layer of circular and longitudinal muscles. In our opinion this mode of inervation of sucker receptors is a consequence of the strong muscle contractions; the receptors can better adapt to the changes in the tegument during contraction or dilatation.

The individual receptor types of the ventral sucker of *B. aequans* correspond generally to the nonciliate receptors of Plathelminthes. The most interesting papillae of the ventral sucker of *B. aequans* were the papillae containing the receptor with strongly vacuolated electron-dense cytoplasm. This receptor type is similar to the nonciliate receptor with electron-dense material localized in domed papilla of the ventral sucker of *Gorgoderina vitelliloba* Ollsson, 1876 described by Hoole and Mitchell (1981). It also resembles the bulbous receptor with much dense material and a membrane bound area of *Multicotyle purvisi* Daves, 1941 (Rohde and Watson 1990). The dense cytoplasm also resembles the cytoplasm of ciliate receptor of *Lobastotrema manteri* Rohde, 1973 (Rohde and Watson 1989). In *B. aequans* adult, in comparison with the cercaria (Žďárská 1983),

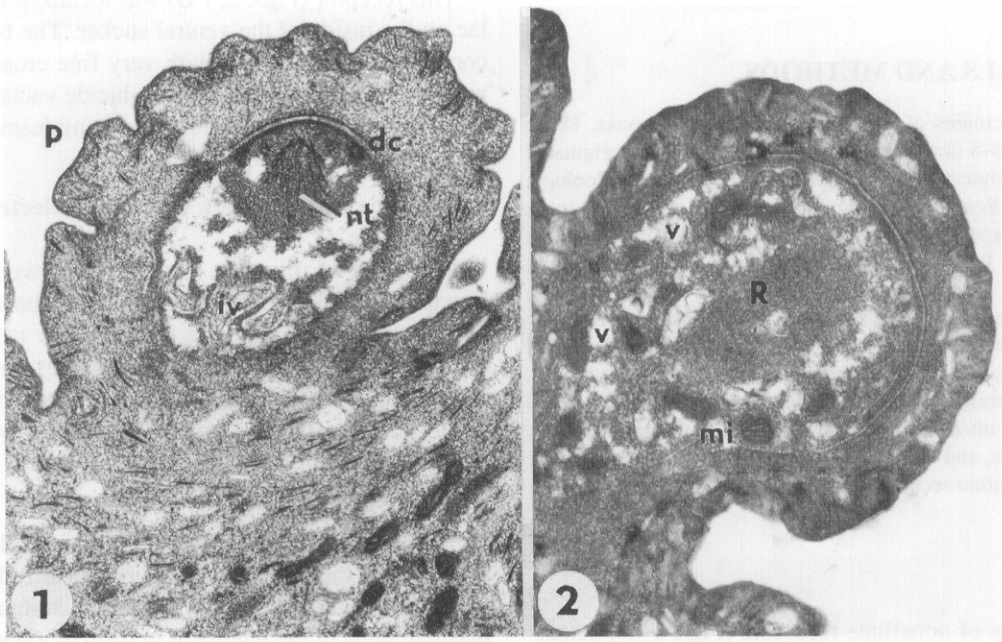

Fig. 1. Receptor with concentrated neurotubules (nt) and one dense collar (dc) localized in a papilla (P) of the outside of the ventral sucker. Note the invaginations (iv) of the tegument in the basal part of the receptor (x 21,300). **Fig. 2.** Receptor with large rootlet (R), mitochondria (mi) and electron-lucid vacuoles (v) localized in a papilla on the inside of the ventral sucker (x 21,300).

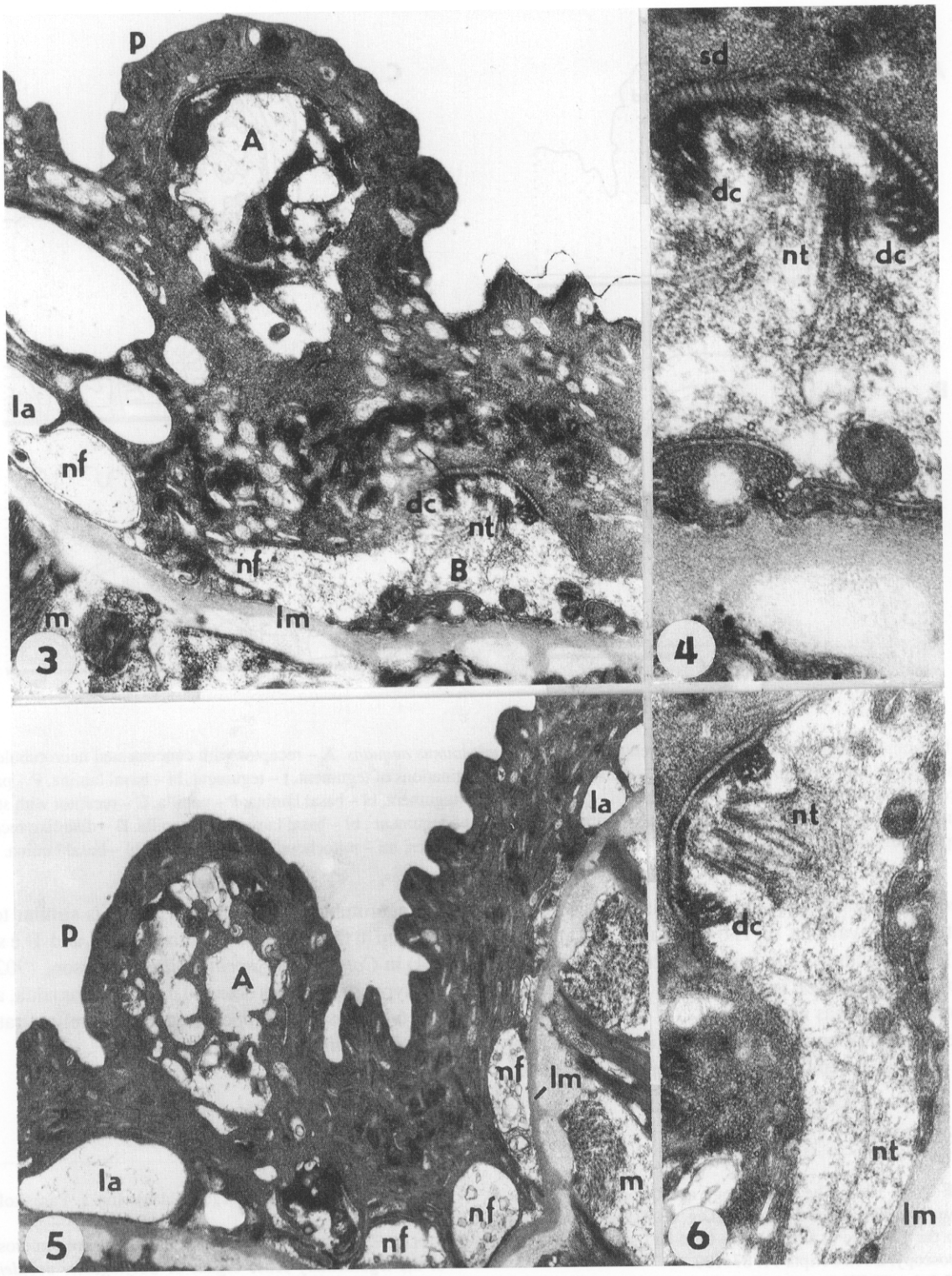

Fig. 3. Receptor with strongly vacuolated dense cytoplasm (A) and disc-like receptor (B). Note in the disc-like receptor one dense collar (dc), concentration of neurotubules (nt) in the apical part and nerve fibre (nf) running parallel with the base of the tegument; la – lacunae in the base of the tegument, lm – basal lamina, m – musculature of the ventral sucker (x 16,700). **Fig. 4.** Detail of the central part of the disc-like receptor (B) from Fig 3; sd – septate desmosome, dc – dense collar, nt – neurotubules (x 47,700). **Fig 5.** Papilla (P) on the inside of the ventral sucker containing a receptor (A) with strongly vacuolated electron-dense cytoplasm. Note the nerve fibre (nf) running parallel with the basal lamina (lm), and the well visible lacunae (la) under the basal plasmalemma of the tegument; m – musculature of the ventral sucker (x 12,470). **Fig 6.** Detail of another section of the disc-like receptor (B) shown in Fig. 3; dc – dense collar, nt – neurotubules, lm–basal lamina (x 28,550).

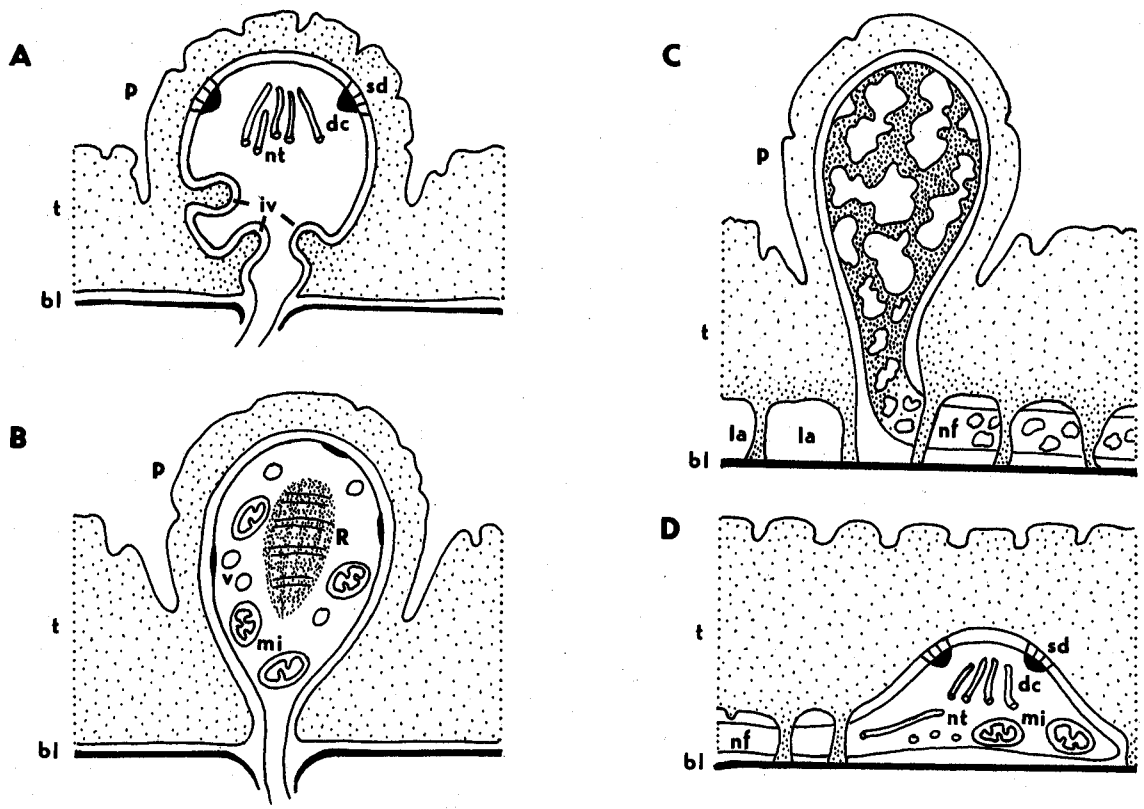

Fig 7. Diagrams of sensory receptors of the ventral sucker of *Brachylaimus aequans*. **A** – receptor with concentrated neurotubules (nt) in the apical part; sd – septate desmosome, dc – dense collar, iv – invaginations of tegument, t – tegument, bl – basal lamina, P – papilla. **B** – receptor with large rootlet (R); v – vacuoles, mi – mitochondria, t – tegument, bl – basal lamina, P – papilla. **C** – receptor with strongly vacuolated electron-dense cytoplasm; nf – nerve fibre, la – lacuna, t – tegument , bl – basal lamina, P – papilla. **D** – disc-like receptor; sd – septate desmosome, dc – dense collar, nf – nerve fibre, nt – neurotubules, mi – mitochondria, t – tegument, bl – basal lamina.

ciliated receptors were not detected. This is in accordance with the observations of Hoole and Mitchell (1981). These authors found ciliated receptors in juvenile *Gorgoderina vitelliloba* only. In the adult trematode this type of receptors was not present.

The concentration of microtubules in the apical part of the disc-like receptor and in the receptor with concentrated neurotubules in *B. aequans* adult is similar to the apical cup in the receptors described by Ip and Desser (1984) in *Cotylogaster occidentalis* Nickerson, 1902.

All types of receptors detected in *B. aequans* adult, at the age of 6–8 days, were nonciliated and entirely intrategumental in location.

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