HELMINTHOLOGIA, 24: 171—181, 1987

Scanning electron microscopy of the tegumental surfaces of some *Orthocoelium species* (Trematoda: Paramphistomata)*

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Received June 16, 1986

Summary

The surface microtopographical details of *Orthocoelium dawesi*, *O. scoliocoelium* and *O. tamilensis*, all inhabiting the rumen of sheep and goats, have been studied by SEM. Observations reveal some structural similarities of the tegument among all the species studied. These are: non-tuberculated nature of the general tegumental surface (with smooth papillae distantly scattered on the ventral surface in *O. scoliocoelium*), conspicuous absence of papillate structures in the area surrounding the genital pore, the occurrence of concentric rings of tegumental folds in the circum-oral region and the pattern of folds and craters in the tegument of the acetabular zone. Interspecific differences pertaining to the nature and pattern of distribution of the papillate structures in the various regions of the body are also revealed.

Key words: Paramphistomes; Digenea; Trematoda; Orthocoelium spp.; surface tegument; fine topography

Introduction

The scanning electron microscopic studies of the tegument in some paramphistome flukes of ruminant hosts have revealed the presence of some fine topographical features specific for every species (Eduardo, 1980a, b, c, 1982, 1983, 1984; Tandon and Maitra, 1981, 1982, 1983). These features pertain to (i) the nature of the tegument on the dorsal and ventral surfaces (ii) the pattern of tegumental folds or ridges in the regions of the mouth, the genital pore and the acetabulum, and (iii) the occurrence and morphology of the putative sensory structures and the pattern of their distribution, particularly in the circum-oral, genital and acetabular areas.

In continuation of our studies on the surface fine morphology of paramphistomes, we describe

* Running title: SEM of tegument in *Orthocoelium* spp.

here the surface topography of three species of the genus *Orthocoelium* (Stiles et Goldberger, 1910) Yamaguti, 1971.

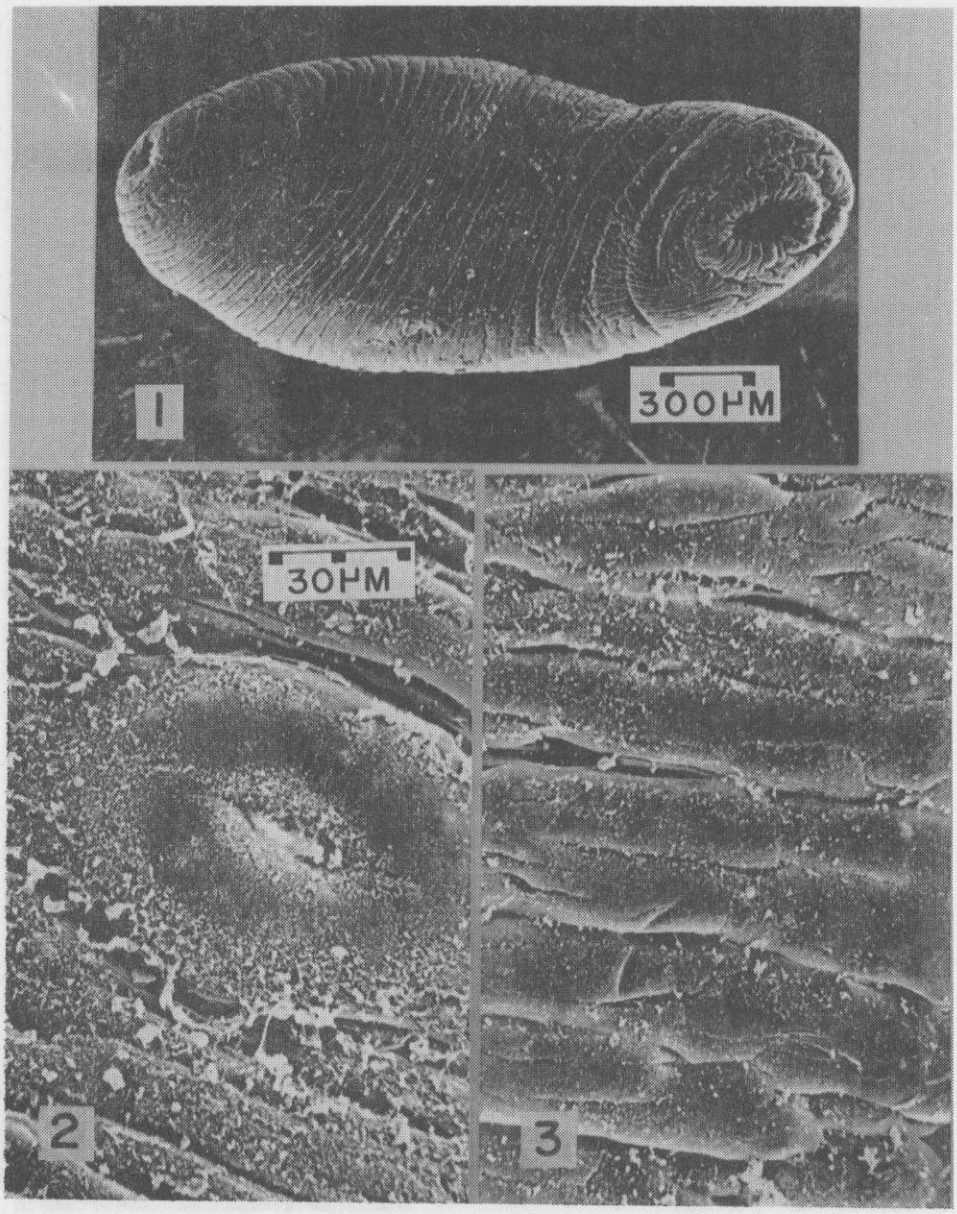
Material and methods

Living paramphistomid flukes were recovered from the rumen of freshly slaughtered sheep. On the basis of the histological characters (Näsmark, 1937; Yamaguti, 1971), viz., the presence or absence of the lip sphincter in the pharynx, the presence or absence of the oesophageal bulb, Laurer's canal not crossing the excretory vesicle or duct, the musculature of the acetabulum, and the structure of the genital atrium (with or without a ventral atrium, genital sphincter and genital radial musculature), these flukes were distinguished as *Orthocoelium dawesi* (Gupta, 1958), *O. scoliocoelium* (Fischoeder, 1904), and *O. tamilensis* (Gupta et Bakshi, in Gupta and Nakhasi, 1977) Eduardo, 1980 (b)). Representative specimens (n = 10) of each of these species were processed for the scanning electron microscopy as described earlier (Tandon and Maitra, 1982). They were observed in a Stereoscan 180 at electron accelerating voltages ranging from 10—20 kv.

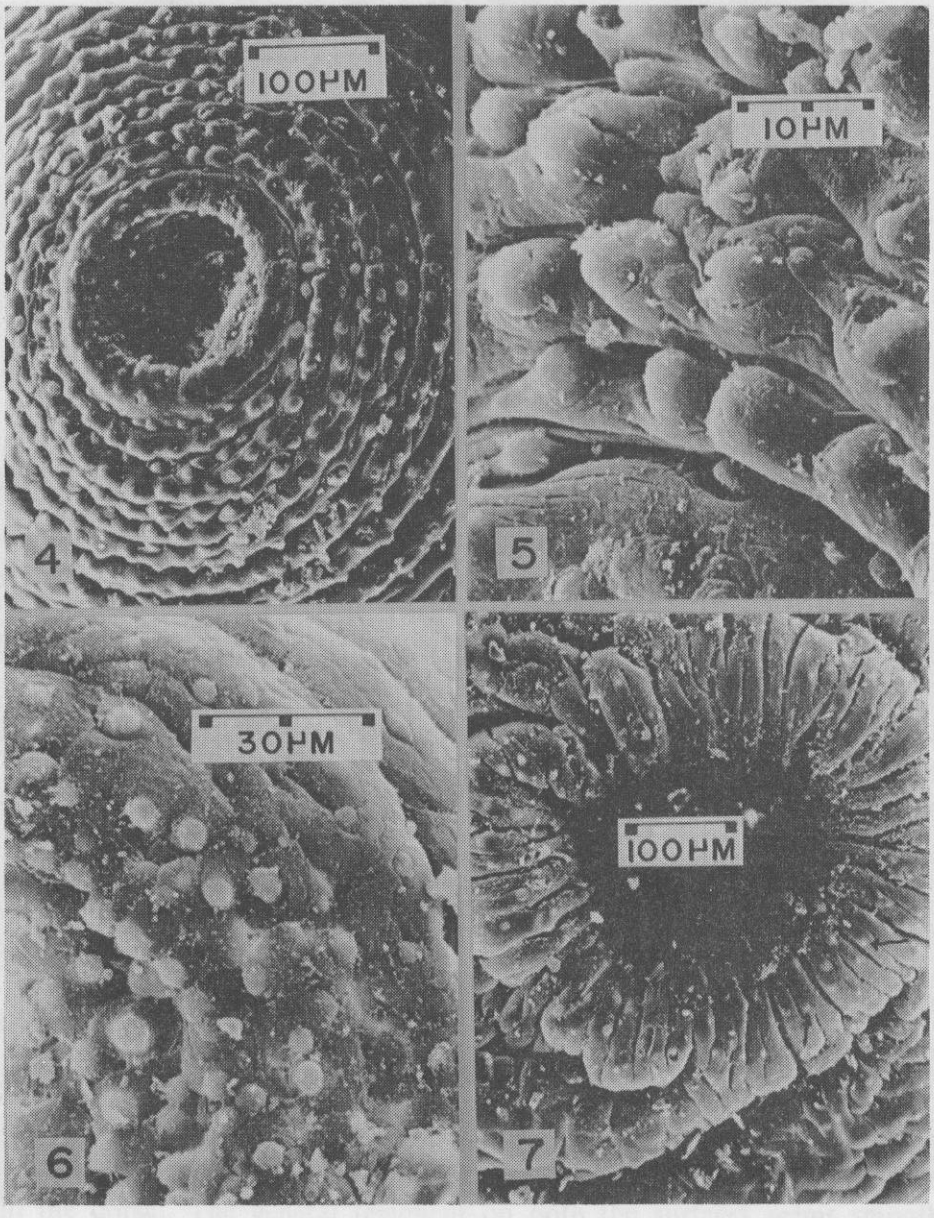
Observations

O. dawesi (Figs. 1—7): Transversely running prominent ridges encircle the body of the worm. These ridges, separated from one another by grooved areas, are broader towards both the extremities and are narrower in the middle region of the body. The dorsal as well as the ventral surfaces are smooth and devoid of any spination or tuberculated structures. The region of the ventrally placed genital pore is clearly demarcated from the surrounding area but the tegument in this region does not exhibit any peculiarity. Regular concentric rows of folds with domed papillae encircle the oral opening. In the proximal few rows the papillae, which are aciliate and smooth, are densely arranged but get coarser in the rings farther away from the oral rim. The buccal lumen is also lined by papillae similar in structure but smaller in size. The tegument covering the rim of the ventro-subterminally situated acetabulum has a pattern of radially oriented folds and ridges. Scantily scattered papillae, similar to the ones present anteriorly, are also found on the acetabular tegument.

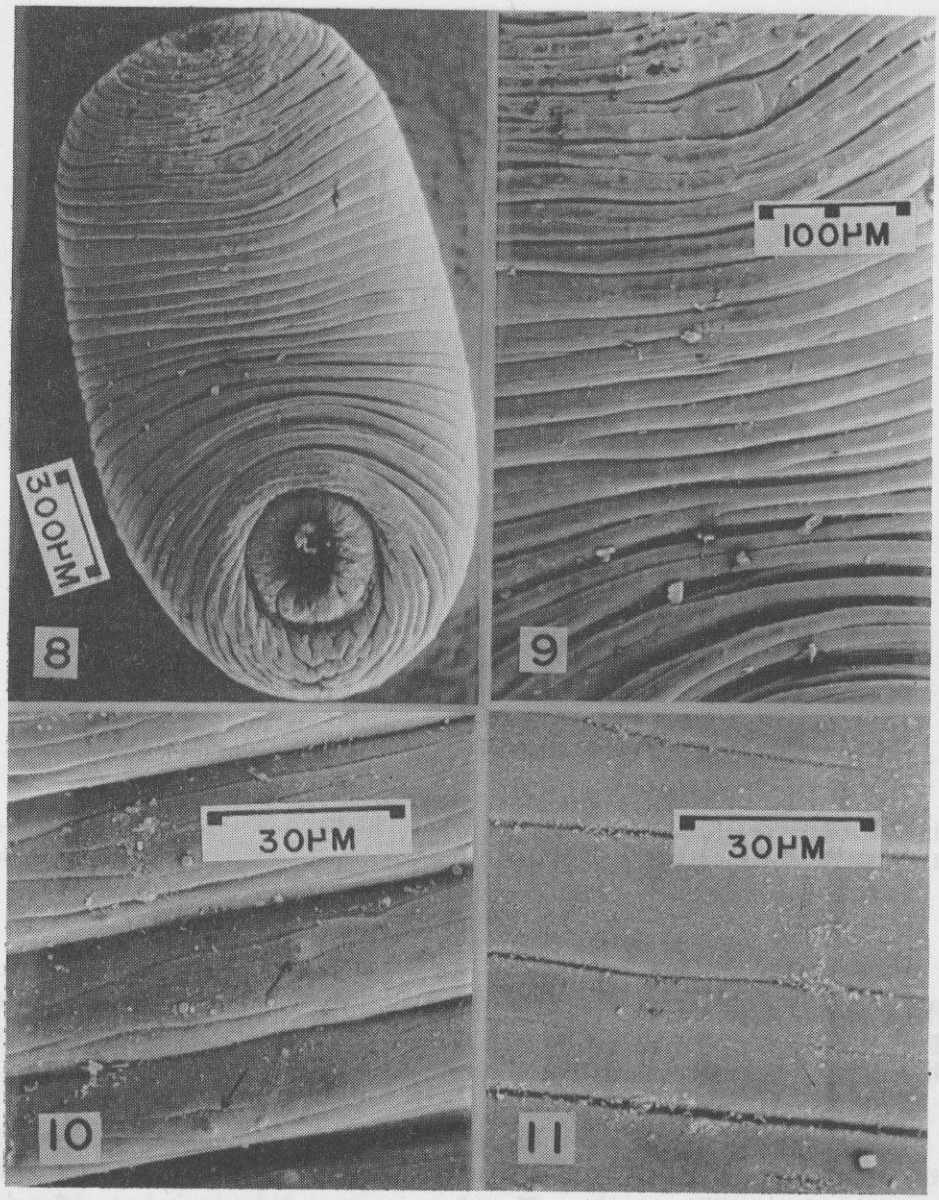
O. scoliocoelium (Figs 8—15): The subcylindrically shaped worm shows a wrinkled surface contour, the wrinkles being deeper on the ventral surface than on the dorsal. The general tegument on both the surfaces seems smooth; however, very distantly scattered tubercles are present on the ventral surface. The tegumental folds surrounding the mouth opening are concentric in arrangement. The proximal 7 to 9 folds are studded with quite regularly arranged round and smooth-surfaced, knob-like elevations. The acetabular surface shows strong radial folds converging towards the aperture of the sucker. Only a few tubercles



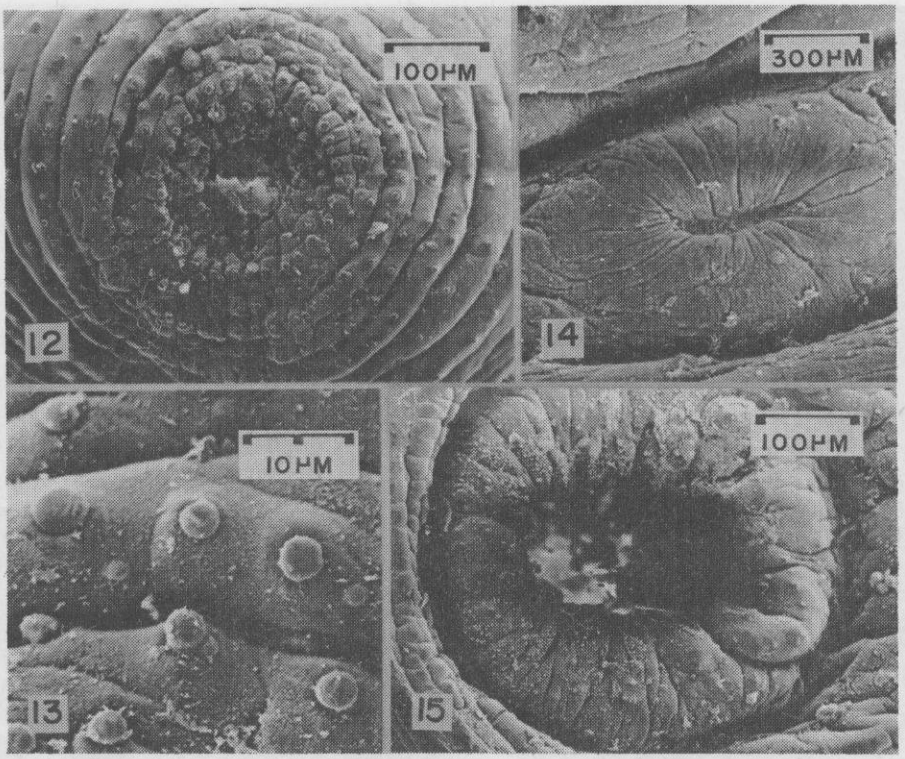
Figs 1—3. *Orthocoelium dawesi*, scanning electron microscopy
1. Full worm (ventral view). 2. A portion of the ventral surface in the region of the genital pore.
3. Tegument of the dorsal surface.



Figs 4—7. *Orthocoelium dawesi*, scanning electron microscopy
4. Oral opening encircled by concentric tegumental folds studded with papillae. 5. An enlarged view of the circum-oral tegument. 6. Interior of the buccal lumen showing papillae. 7. Topography of the tegument in the acetabular region. Note the scantily scattered papillae (arrows).



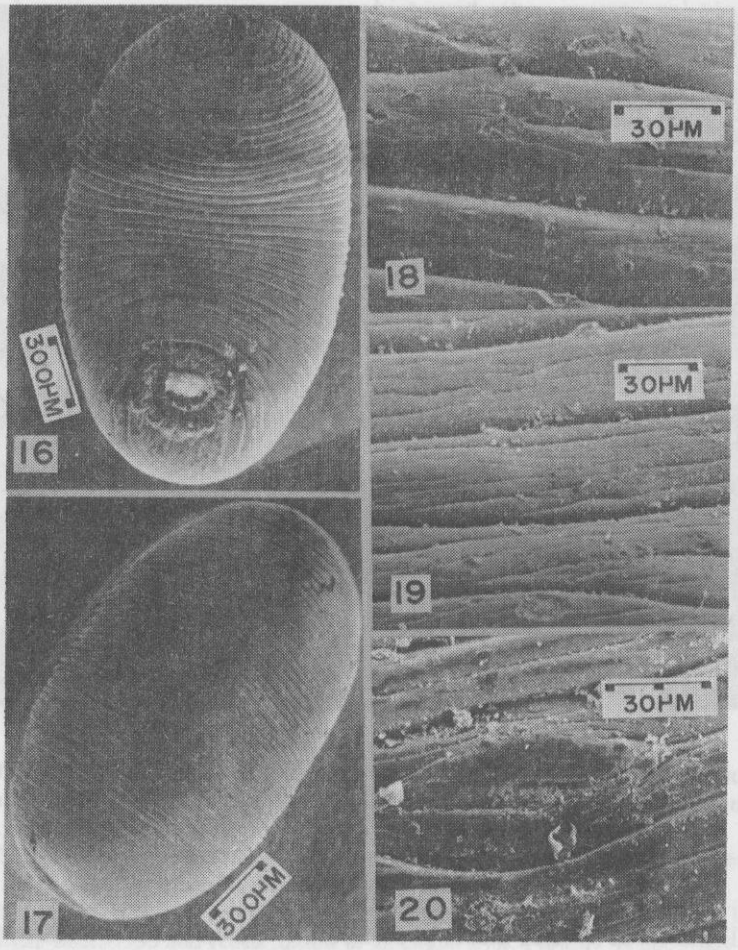
Figs 8—11. *Orthocoelium scoliocoelium*, scanning electron microscopy
8. Full worm (ventral view). 9. Ventral surface showing deep folds of tegument; the genital pore is also distinct. 10. Ventral surface under higher resolution. Note the presence of distantly scattered tubercles (arrows). 11. Tegument of the dorsal surface.



Figs 12—15. *Orthocoelium scoliocoelium*, scanning electron microscopy
12. Concentrically arranged tegumental folds with knob-like elevations around the mouth opening. 13. A magnified view of the knob-like elevations. 14. Tegument in the genital pore region, showing radial foldings. 15. Acetabular region showing lightly papillated tegument with radial folds.

are present on the tegument in this region. Similarly, the region of the genital pore is also demarcated from the surrounding area by radial folds of tegument, however, no papillae were observed on the latter.

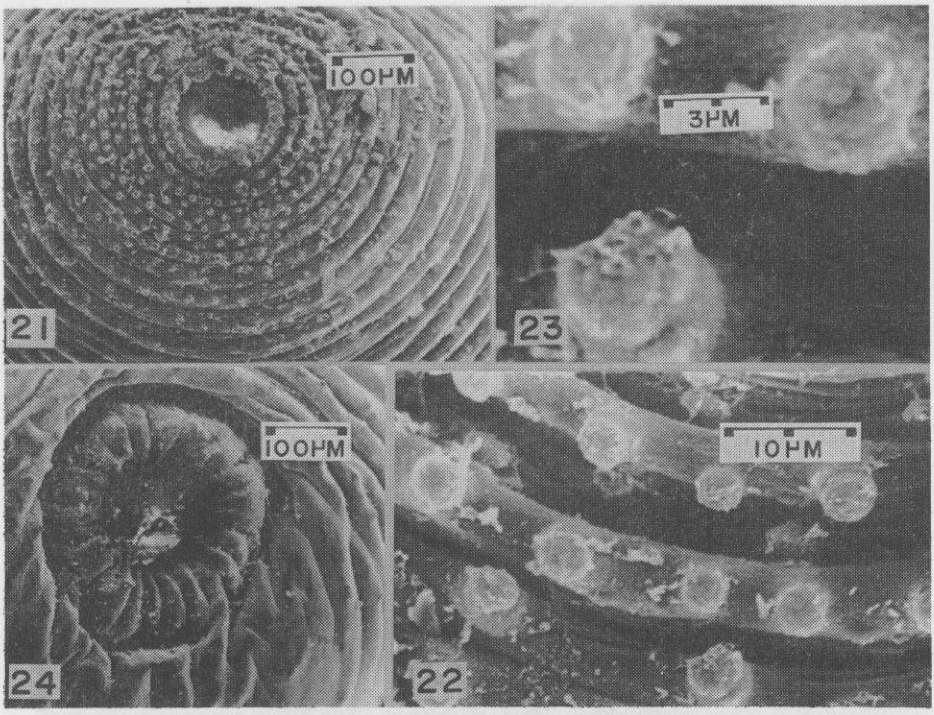
O. tamilensis (Figs 16—24): Transversely running folds encircle the body of the worm. Both the dorsal and the ventral surfaces are observed to be devoid of any tubercles, papillae or spines. The tegument around the genital pore also did not reveal any peculiar feature. About eleven to fourteen circum-oral concentric rings of ridged folds are present and each is separated from the other by a deep grooved area. Knob-like papillae (domed, aciliate but not with smooth surface) are studded on these ridges. The tegumental folds exhibit a radial orientation in the acetabular region where the papillate structures show a scanty distribution.



Figs 16—20. *Orthocoelium tamilensis*, scanning electron microscopy
16, 17. Entire worm in ventral and dorsal views, respectively, showing prominent transverse wrinkles of the general tegument. 18, 19. Tegument of the ventral and dorsal surface, respectively, showing absence of any papillate or tuberculate structures. 20. Tegument of the genital pore region.

Discussion

The tegument in all the species of *Orthocoelium* studied herein is shown to be a non-tuberculated surface which in *O. scoliocoelium* is studded with smooth papillae that are scattered distantly on the ventral surface. The tegument of the anterior quarter or one-third body length is reported to be papillated in two other orthocoelliine species, namely, *Orthocoelium indonesiense* and *Leiperocotyle okapi* (see Eduardo, 1980b, c).



Figs 21—24. *Orthocoelium tamilensis,* scanning electron microscopy
21. Concentric arrangement of tegumental folds at the oral extremity. 22. Circum-oral tegumental surface showing the deep grooves and folds with domed papillae. 23. A view of the latter under higher resolution. 24. Pattern of regular folds of the acetabular tegument.

In all the three species under present study the area surrounding the genital pore is conspicuously devoid of papillae or other tegumental patterns. In *O. indonesiense* the genital pore is encircled by papillae; in *Bilatorchis papillogenitalis* there are club-shaped papillae with smooth surfaces (Eduardo, 1980a). Two to three concentric rows of papillae surround the genital pore in *Gastrodiscoides hominis* as well (Tandon and Maitra, 1983)

The occurrence of circum-oral concentric rings of tegumental folds with papillae of different types on them seems to be a feature common to all the *Orthocoelium* species under present study. These folds have a very characteristic arrangement in *O. tamilensis.* While in *O. dawesi* the papillae or elevations are domed, aciliate and smooth surfaced, in *O. tamilensis* they are knob-like, aciliate but not smooth surfaced; in *O. scoliocoelium* the papillae, relatively few in number, are bead-like smooth and round knobs. In *B. papillogenitalis,* the circum-oral papilae have each 14—22 apical knob-like projections (Eduar-

do, 1980a). In other mammalian paramphistomids the circum-oral tegumental features appear as a single row of papillae (in *Gastrothylax crumenifer*), irregularly scattered patches (in *Paramphistomum epiclitum*), deep pits (in *Calicophoron papillosum*), papillae and elevations with pits on their tips (in *C. calicophorum*), or numerous bosses and patches arranged in 2—3 rows (in *Gastrodiscoides hominis*) (see Tandon and Maitra, 1981, 1982, 1983).

In all the species under present study the tegument in the acetabular area is with radial folds and scanty papillae on the latter (as in. *O. scoliocoelium*). A characteristic pattern of ridges, folds and craters with putative sensory structures in the acetabular region is exhibited by the paramphistomes other than orthocoeliine also (Tandon and Maitra, 1981—1983). The tegumental patterns in this region are a reflection of the underlying musculature of the posterior sucker.

Acknowledgements

Thanks are due to the Director, Central Drug Research Institute, Lucknow, for permission to use SEM facility. This investigation was supported in part by the UGC grant no. 13640 to VM.

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Растровая электронная микроскопия тегументарных поверхностей некоторых видов рода *Orthocoelium* (Trematoda: Paramphistomata)

Выводы

Авторы при помощи растровой электронной микроскопии изучали микротопографические детали поверхности тела *Orthocoelium damesi, O. scoliocoelium* и *O. tamilensis* паразитирующих в рубце овец и коз. При этом авторы определили, что изучаемые виды имеют определенные друг другу подобные тегументарные признаки. Именно: общий тегументарный покров без буголков (у *O. scoliocoelium* с гладкими раструшенными, друг от друга значительно отдаленными сосочками на его вентральной поверхности), явное отсутствие сосочковидных структур в области генитального поруса, наличие концентрических кольцевидных тегументарных складок в циркуморальной зоне и форма складок и кратеровидных углублений в тегументе ацетабулярной зоны. Также были определены междувидовые различия в отношении характера и способа размещения сосочковидных структур в разных областях тела.

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Die Rasterelektronmikroskopie der tegmentellen Oberflächen einiger Arten der Gattung *Orthocoelium* (Trematoda: Paramphistomata)

Zusammenfassung

Die Verfasser studierten mit Hilfe der Rasterelektronmikroskopie mikrotopographische Details der Körperoberfläche von *Orthocoelium dawesi, O. scoliocoelium* und *O. tamilensis*, parasitierend im Wanst von Schafen und Ziegen. Dabei hat es sich gezeigt, dass die beobachteten Arten bestimmte gegenseitig ähnliche tegmentelle Zeichen haben. Dies sind: der gänzliche tegmentelle Schutz ohne Häckerchen (bei *O. scoliocoelium* mit glatten verstreuten, voneinander erheblich entfernten Papillen an seiner Ventralfläche), deutliches Fehlen der papillenartigen Strukturen in der Umgebung des Genitalporus, das Vorkommen konzentrischer ringförmiger tegmenteller Falten in der zirkumoralen Zone und die Form der Falten und der kraterförmigen Vertiefungen im Tegmentum der Acetabularzone. Es wurden auch zwischenartige Verschiedenheiten festgestellt, sofern es sich um die Beschaffenheit und Art der Dislokation der papillenartigen Struktur in verschiedenen Gebieten des Körpers handelt.

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S. C. Maitra

Rastrovacia elektrónová mikroskopia tegumentárnych povrchov niektorých druhov rodu *Orthocoelium* (Trematoda: Paramphistomata)

Súhrn

Autori pomocou rastrovacej elektrónovej mikroskopie študovali mikrotopografické detaily povrchu tela *Orthocoelium dawesi, O. scoliocoelium* a *O. tamilensis*, parazitujúcich v bachore oviec a kôz. Pritom sa ukázalo, že sledované druhy majú určité navzájom podobné tegumentárne znaky. Sú to: celkový tegumentárny kryt bez hrbolčekov (u *O. scoliocoelium* s hladkými roztrúsenými, od seba značne vzdialenými papilami na jeho ventrálnej ploche), zreteľné chýbanie papilovitých štruktúr v okolí genitálneho pórusu, výskyt koncentrických prstencovitých tegumentárnych záhybov v cirkumorálnej zóne a forma záhybov a kráterovitých prehĺbenín v tegumente acetabulárnej zóny. Zistili sa tiež medzidruhové odlišnosti, pokiaľ ide o povahu a spôsob rozloženia papilovitých štruktúr v rôznych oblastiach tela.

V. Tandon
S. C. Maitra

New books

M.D. Sonin (Ed.): *Questions of helminth biocenology (Voprosy biotsenologii gelmintov). Trudy Gelmintologicheskoy laboratorii Akademii Nauk SSSR*, Vol. 35. Publ. House „Nauka" — Moscow, 1986. Pp. 1—178. Price 2 Rb 70 K

The reviewed volume of the well-known *Trudy Gelan* is a collection of 24 papers, most of which have a common link — ecological nature of research, which has found full use at the very helminthological workplace, which ranks among the leading research institutions of the Academy of Sciences. Prevailing in number are papers from fytohelminthology and on the invertebrate group having the role of intermediate hosts of trematodes and cestodes. Less frequent, though highly topical, are papers on mathematical methods used in studies of ecology of helminths, of their biochemical (metabolic) peculiarities (serotonine, ferments, cadaverine). The least represented are papers dealing with biology and systematics of helminths of insects, with helminth fauna, and exogenous development of helminths (nematodes) of herbivorous etc. The composite book is concluded by a list of type specimens of flatworms deposited in collection of Helminthologicaly Laboratory of the USSR Academy of Sciences, which will undoubtedly contribute to promotion of collaboration among helminthologists — systematics.

Papers included in the composite book were mostly written by well-known Soviet helminthologists. For their high professional level the papers will greatly contribute to studies of zoohelminthoses and phytohelminthoses. Valuable are also practical (particularly epizootiological) aspects of some papers published. The external arrangement of the book is traditionally of a high level. This also applies to illustrations supplement to pen-and-ink drawings and graphs in particular. Acquaintance with the contents of the particular papers in the book gives an opportunity for better understanding of the topical subject matter, which has been sold in the Soviet Union in the field of general and special helminthology. The composite book affords interesting and important data for helminthologists, parasitologists and zoologists of broad concern as well as for agronomists and veterinary surgeons, specializing in invasive diseases and helminthoses.

M. Breza

(Helminthologia, 24, 1987; 3: 182)