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MORPHOLOGY AND HISTOCHEMISTRY OF CYSTICERCOIDS OF THREE CESTODE SPECIES OF THE GENUS TRIODONTOLEPIS YAMAGUTI, 1959 (HYMENOLEPIDIDAE)

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Abstract. Cysticercoids of the cestodes *T. bifurca* (Hamann, 1891), *T. hamanni* (Mrázek, 1891) and *T. sumavensis* Prokopič, 1957 recovered from the body cavity of *Gammarus* (*Rivulogammarus*) *fossarum* Koch, 1835 were studied for the first time by histological and histochemical methods. The size of cysts is 228—247 × 156—228 μm in *T. hamanni*, 282—456 × 176—267 μm in *T. bifurca* and 447—586 × 298—396 μm in *T. sumavensis*. The tail is developed, rather long, and lobular in the basal part. The species may be differentiated on the basis of the hook length: *T. hamanni* — 15—20 hooks measuring 26—31 μm, *T. bifurca* — 10 hooks measuring 47—64 μm, and *T. sumavensis* — 10 hooks measuring 72—76 μm. The cysts are oval or slightly flattened. Shortly after the invagination the neck separates from the cyst wall and lies freely in its cavity together with the scolex. The flattening of the cyst is caused by the one-sided growth of the cellular layer of subtegument, in which the muscle, connective tissue and argyrophilic fibres are proliferated. The microvilli of the cyst tegument are 1—38 μm long and contain acid mucosubstances with COOH-groups and sulphogroups. The microtriches in the tegument of scolex and neck measure 2—4 μm and contain neutral and acid (with sulphogroups) mucosubstances, and proteins with tyrosine, SH- and SS-groups. Proteins with SS-groups were detected in rostellar hooks. The wall of the longitudinal excretory canals of scolex and neck contain proteins with arginine, tyrosine, SH-groups and hydrophilic lipids.

The present paper is a part of comparative morphological studies on cestode larvae of the family Hymenolepididae Fuhrmann, 1907 developing in aquatic invertebrates (Valkounová 1983, 1984, 1985). Of the genus *Triodontolepis*, cysticercoids of *T. bifurca*, *T. hamanni* and *T. sumavensis*, the adults of which parasitize hosts of the genus *Neomys* in the Palaearctic subregion, were studied.

MATERIAL AND METHODS

The cysticercoids were collected in the years 1979—1981. They were recovered from the body cavity of naturally infected *Gammarus* (*R.*) *fossarum* collected in the brooks in the vicinity of Pyšely, Kamenný Újezd, Písek and Vimperk. The cysticercoids were fixed in neutral formaldehyde (Pearse 1968) and for the detection of tryptophan in Baker's fixation adjusted with 0.1 N NaOH to pH 6.5 (Lojda 1965). After embedding into paraffin, 6 μm thick sections were cut. The following histological methods were then used: Mayer and Weigert's haematoxyline-eosine, van Gieson's method, Masson and Goldner's trichrome, Mallory's PTAH method, aldehyde-fuchsine, Gomori's impregnation test and Kóssa's method for the detection of calcium. Neutral and acid mucosubstances, proteins and lipids were detected by 21 histochemical tests (for the description of methods see Pearse 1968).

RESULTS

1. Morphology of the cysticercoid

The cysticercoid of the three studied species is a tailed cyst in the cavity of which freely lies the scolex with neck (Plate I, Fig. 1). Shortly after the invagination the neck separates from the cyst wall so that it does not form a continuous layer surrounding the scolex. In some cysts, a 1 μm thick fibrous envelope surrounds both the cyst and tail (Plate I, Fig. 2). The tail was always situated in the posterior part behind the cyst. The fibrous envelope was often damaged or lacking. It could not be assessed what was its origin, it probably arose from the outer part of the digestive tube of the host. The most important metrical data are given in Table 1.

Table 1. Measurements of the cysticercoids (in μm)

	T. hamanni	*T. bifurca*	*T. sumavensis*
cyst	228—247 × 156—228	282—456 × 176—267	447—586 × 298—396
tail	85—114 × 45—57	230—329 × 73—102	380—418 × 98—106
scolex	138—201 × 121—199	263—292 × 240—282	285—309 × 258—300
suckers	57—68 × 35—57	98—133 × 57—103	120—145 × 76—102
rostellar sac	84—113 × 64—95	152—186 × 121—131	210—245 × 125—132
rostellum	38—69 × 38—57	121—149 × 89—101	156—189 × 103—110
hooks length	26—31	47—64	72—76
hooks number	15—20	10	10
neck	95—152 × 39—65	289—304 × 67—87	335—380 × 85—108

CYST

The cyst is oval in vertical section and round or oval in horizontal section. The tail is 200—800 μm long, in the part adhering to the cyst wall it is wide and lobular (Plate II, Fig. 1). It is often separated for a greater part. Embryonal hooks measuring 0.008 μm in length are situated in posterior half of the tail. The surface of the cyst and tail is covered with 1 μm thick outer limiting layer which is refractile, often damaged and cannot be stained by any of the histological methods. The microvilli are 4—19 μm long, in *T. sumavensis* even 38 μm. They are longest at the site of invagination (11—19 μm, in *T. sumavensis* 29—38 μm) at the opposite pole they measure 7—9 μm (15—26 μm in *T. sumavensis*), and at the lateral sides of cyst at the flattened sites they are 3—4 μm long (in *T. sumavensis* 8—10 μm). In the remaining parts they are usually 5—7 μm (12—14 μm. in *T. sumavensis*) long. Some cysts of *T. sumavensis* had the longest microvilli at the site of invagination (29 μm long), but the length gradually decreased towards the opposite pole. At the lateral sides, the microvilli were 9—19 μm long, in the flattened part only 5—11 μm, and at the site where the tail grows, only 3—7 μm. The microvilli (Plate II, Fig. 2) stained rose-red by haematoxyline-eosine, grey-rose and sometimes grey-yellow by van Gieson's method, red in Masson and Goldner's trichrome, and brown-black by Gomori's method. The amorphous substance of the cyst tegument was 1—2 μm high and without any structure visible in the light microscope. It stained faint rose in hematoxyline-eosine, Masson and Goldner's

trichrome and deep rose by Gomori's method. The tail tegument was 1 μm thick and could not be discerned in the light microscope. It stained in the same way as the amorphous substance of the cyst tegument. The basement layer of the cyst was homogeneous, up to 1 μm thick, and a slightly fibrilar structure was visible in some sections. It stained grey with Gomori's method. This layer was not differentiated in the tail. The layers situated above the subtegument were often torn off in the histological section.

The subtegument of the cyst consisted of outer and inner muscle and connective tissue parts and middle cellular part (Plate II, Fig. 1). The outer part of the subtegument was divided into circular layer of muscle and connective tissue fibres and longitudinal layer situated under the circular one. Each layer was about 4—5 μm thick and contained muscle fibres regularly arranged in a row. The muscle fibres were oval in section and measured 4 × 2 μm in *T. sumavensis*, whereas in the other two species, they were almost round in section and measured 3 μm in the diameter. The spaces between them were 3—7 μm wide, according to the dilatation of the cyst. The connective tissue fibres were 1 μm thick and they were arranged around the muscle fibres in such a way that they formed a continuous layer. Fine argyrophilic, up to 0.5 μm thick fibres were situated on the surface of both circular and longitudinal layers of muscles and connective tissue. The muscle fibres stained red with haematoxyline-eosine, deep red with Masson and Goldner's trichrome, yellow with van Gieson's method, rose with PAS and blue-grey with Gomori's method. The connective tissue fibres stained rose with haematoxyline-eosine, red with van Gieson's method, blue with Masson's trichrome, green with Goldner's trichrome and rose with Mallory's PTAH method. This layer was not found in the tail.

The thickness of the cellular layer of subtegument was variable, 4—102 μm on the average. This layer was thickest at the site of invagination (35—70 μm), whereas on lateral sides of the cyst it gradually attenuated from 25 to 8 μm and at the site where the tail grows, it measured again 25—45 μm. In some cysts of *T. sumavensis* the cellular layer was thickest at the site of invagination (80—102 μm), but it gradually attenuated towards the opposite pole. On lateral sides of cysts, it was 40—50 μm thick (in the flattened part 4—8 μm, sometimes it was not visible) and at the site of invagination, it was only 15—26 μm thick. The cellular layer of the subtegument contained regularly arranged tegument-forming pyriform cells. The nucleus was situated in the posterior, widened part of cells under the longitudinal layer of muscle and connective tissue fibres. The elongated anterior part of cells penetrated through the longitudinal and circular layers of muscle and connective tissue and was connected with the amorphous substance of the tegument. The cells measured 11—18 × 3—5 μm, and their nucleus 2—3 μm and nucleolus 0.5—1 μm in diameter. The nucleus stained violet-blue and the nucleolus deep violet-black with haematoxyline-eosine. Some of the cells contained two nucleoli. The plasma of cells stained in the same way as microvilli, but in a lighter tint. In addition to the tegument-forming cells, this layer contained also cytoplasmic parts of muscle cells with nuclei, fibroblasts or their fusiform nuclei and calcareous bodies measuring 5—15 μm in diameter and sometimes accumulated in clusters (Plate II, Fig. 1). The cells, nuclei and calcareous bodies were situated in the network of muscle and connective tissue fibres forming a 1—4 μm thick continuous longitudinal layer on the inner side of cyst (Plate II, Fig. 1). The cells and fibres were covered by fine argyrophilic fibrils. The inner limiting layer was 1 μm thick, could not be stained by any of the used methods and was visible only due to its refractility. The tissue under the tail tegument had the same character as the cellular layer of cyst subtegument and also cohered with it. The tegument-forming cells in the tail were

smaller (maximally 5 × 2—3 μm) and the calcareous bodies were not demonstrated. The muscle and connective tissue fibres were finer.

In some section of *T. sumavensis* stained with haematoxyline-eosine, the arrangement of the cyst wall was somewhat different. The cellular part of the subtegument contained, in addition to tegument-forming cells, particularly in the inner zone, larger cells (15—25 × 5—7 μm) of identical shape, the plasma of which did not stain with haematoxyline-eosine and the nucleus (3—4 μm in diameter) was light, with one, excentrically situated, dark nucleolus (1 × 1 μm) (Plate III, Fig. 1). These cells were also connected with the amorphous substance of the tegument through their narrowed parts. Fine fibres directed radially to the outer surface of cyst and not staining by haematoxyline-eosine projected from the plasma of these densely situated and contracted cells. The fibres were not seen in those parts of the flattened cysts, where the cellular layer of subtegument was thin.

Table 2. Histochemistry of the cysticercoid of the genus *Triodontolepis*

Reaction	Outer limiting layer of the cyst, neck and scolex	Cyst					Scolex and neck				
		Tegument		Subtegument			Tegument		Subtegument		
		Microvilli	Amorphous substance	Connective tissue fibres	Muscle fibres	Pyriform cells	Microtriches	Amorphous substance	Connective tissue fibres	Muscle fibres	Pyriform cells
PAS	++/+++	±	±	–	++	–	+/++	+/++	–	++++	–
Schiff	–	–	–	–	–	–	–	–	–	–	–
Saliva test + PAS	++/+++	±	±	–	+	–	+/++	+/++	–	++	–
Acetylation + PAS	–	–	–	–	–	–	–	–	–	–	–
Desacetylation + PAS	++/+++	±	±	–	++	–	+/++	+/++	–	++++	–
Best's carmine	++/+++	–	–	–	+++	–	++	++	–	+++++	–
Saliva test + Best's carmine	++/+++	–	–	–	++	–	++	++	–	++	–
AB pH 2.6	++ *	+++++	++	++++	–	+++	++++	++	++++	–	++
Methylation + AB pH 2.6	–	–	–	–	–	–	–	–	–	–	–
Demethylation + AB pH 2.6	++	+++	++	–	–	++	–	+	–	–	++
AB + PAS	red	violet	blue	dark blue	red	blue	violet	violet	blue	red	blue

* only in the cyst

Both the neck and scolex were localized within the cyst cavity where they were movable and surrounded by a dense fluid. This fluid was gelatinous in older cysticercoids. After fixation of the cysticercoid its continuity was interrupted and only remnants of it remained on the surface of scolex, neck or inner wall of cyst. The outer limiting layer was 1 μm thick and refractile. The tegument was differentiated into microtriches and amorphous substance. The microtriches were longest on the surface of scolex. In the vicinity of rostellum they were 3 μm long and in the posterior part of scolex they gradually diminished up to 2 μm. On the surface of neck they measured only 1 μm. Also the thickness of the amorphous substance of tegument gradually decreased from 2 μm around the rostellum to 1 μm in the remaining parts of scolex and neck. The basement layer was 1 μm thick and it

Reaction	Scolex and neck			Scolex				Gelatinous matter
	Parenchyma							
	Connective tissue fibres	Muscle fibres	Parenchyma cells	Connective tissue fibres of the rostellum and rostellar sac	Connective tissue fibres of the suckers	Muscle fibres of the rostellum, rostellar sac and suckers	Cells of the rostellar sac	
PAS	–	+++	+++	–	–	+++/++++	++/+++	+++/++++
Schiff	–	–	–	–	–	–	–	–
Saliva test + PAS	–	+	+	–	–	+/++	++/+++	++
Acetylation + PAS	–	–	–	–	–	–	–	–
Desacetylation + PAS	–	++	++	–	–	+++/++++	++/+++	+++/++++
Best's carmine	–	++++	+++++	–	–	++++	++++	++++
Saliva test + Best's carmine	–	+	+	–	–	+	++	++
AB pH 2.6	++	–	+	++++	+	–	++	++
Methylation + AB pH 2.6	–	–	–	–	–	–	–	–
Demethylation + AB pH 2.6	++	–	+	–	+	–	++	++
AB + PAS	blue	red	red	dark blue	pink blue	red	red	violet

Table 2. (continued)

Reaction	Cyst					Scolex and neck	
	Tegument		Subtegument			Tegument	
	Microvilli	Amorphous substance	Connective tissue fibres	Muscle fibres	Pyriform cells	Microtriches	Amorphous substance
Sakaguchi	+/++	–	–	+	+	+	–
Morel-Sisley	–	–	–	+	–	+++	±
DMAB	+	+	–	++	–	+	+
Coupled tetrazonium reaction	+	+	++	++	+	+++++	+++
DDD	±	±	+	++	±	++	++
Thioglycollic acid + DDD	+	+	++	+++	+	+++	+++
PFA — AB	++	++	+	+	±	++	++
AB pH 0.2	+	+	++	+	+	++	+
PAA-aldehyde fuchsin	++	+	++	+	+	+++	+++
Aldehyde fuchsin	+	+	+	+	–	+++	+
Sudan black B (paraffin)	±	±	++	+	±	++	+
Luxol blue	–	–	+++	–	–	+++	++

was not visible in some sections. The circular and longitudinal muscle and connective tissue layers of subtegument were 2—3 μm thick on the average. The thickness of muscle fibres was approximately 2 μm and of connective tissue fibres 1 μm. Muscle fibres were more numerous than in the cyst subtegument. The tegument-forming cells situated under the muscle and connective tissue layer of subtegument of both scolex and neck were smaller than that in the cyst wall. They measured 5—8 × 2—3 μm, their nucleus 2 μm and nucleolus 1 μm. The rostellar sac in these cestode species was conspicuous like in the genus *Coronacanthus* Spassky, 1954. In addition to well developed, 4—5 μm thick muscle fibres serving for the movement of rostellum, there were cells measuring up to 7 μm in diameter and arranged in palisade. Their nuclei measured 3 μm and nucleoli 0.5—1 μm in diameter. In the studied material they could not be exactly distinguished from myoblasts. The inner parenchymatous part of scolex and neck had already the structure typical of adult cestodes. It contained muscle and connective tissue fibres, parenchyma cells, fine argyrophilic fibrils and calcareous bodies measuring 2—3 μm in the diameter. Two pairs of excretory canals began under the suckers and extended on both sides of

Reaction	Scolex and neck								Gelatinous matter
	Subtegument			Parenchyma					
	Connective tissue fibres	Muscle fibres	Pyriform cells	Connective tissue fibres	Muscle fibres	Parenchyma cells	Cells of the rostellar sac	Hooks	
Sakaguchi	–	+	+	–	++	++	+	–	++
Morel-Sisley	–	+++	++	–	++	+	++	–	–
DMAB	–	+/++	–	–	+/++	–	+	–	–
Coupled tetrazonium reaction	++	++++	+++	+	++++	++	++++	–	+++
DDD	++	+++	++	++	+++	+	+	–	++
Thioglycollic acid + DDD	+++	+++	+++	+++	+++	+	+	++	+++
PFA — AB	+	–	++/+++	+	–	–	+	++++	+++
AB pH 0.2	+	–	+	+	–	±	+	+++	++
PAA-aldehyde fuchsin	++	+	++	++	+	–	+	++++	+++
Aldehyde fuchsin	+	–	–	+	–	–	–	+++	++
Sudan black B (paraffin)	++	–	+/++	++	–	++	+++	–	–
Luxol blue	+++	–	+	+++	–	–	+/++	–	++

scolex and neck. No excretory canals were found in the cyst wall. Individual elements of the scolex and neck stained in the same way as those of the cyst wall. Typical of the whole genus were Y-shaped hooks, in profile with bifurcate guard and handle as long as or longer than blade (Plate III, Fig. 2; Plate IV, Figs. 1, 2).

2. Histochemistry of the cysticercoid

The occurrence of mucosubstances, proteins and hydrophilic lipids was approximately the same in all of the studied representatives of the genus *Triodontolepis*, therefore it could be evaluated in a common table (Table 2). The outer limiting layer of the cyst, neck and scolex contained neutral mucosubstances. The outer limiting layer of the cyst was AB positive, which was caused by the fact that the apical parts of microvilli reached up to this layer. The inner limiting layer gave no positive reaction in any of the tests. The microvilli of the cyst tegument contained acid mucosubstances with COOH— and sulphogroups. The microtriches

of the scolex and neck tegument contained a small amount of neutral mucosubstances, acid mucosubstances with sulphogroups, protein with tyrosine, histidine, SH-groups and a small amount of SS-groups, and tryptophan. The tegument-forming cells had a similar histochemical structure as the tegument. The connective tissue fibres contained acid mucosubstances, proteins with SH- and SS-groups and hydrophilic lipids. The muscle fibres contained glycogen and other neutral mucosubstances, proteins with tyrosine, tryptophan, arginine and SH-groups, and neutral lipids. The cells of the rostellar sac contained mainly neutral and acid musosubstances. The hooks contained proteins with cystine. The wall of longitudinal excretory canals of the scolex and neck contained arginine (++), tyrosine (++), hydrophilic lipids (++), and a small amount of proteins with SH-groups.

DISCUSSION

Our studies on the cysticercoids infecting hosts of the genus *Gammarus* (Valkounová 1983, 1984, 1985) show that during the stay of the parasite inside the body cavity of the host, the growth of the cyst wall is uneven and results in a change of its shape. The spherical and oval cysts become flattened so that they resemble in their shape the body of the host (genus *Coronacanthus* — lenticular, genus *Triodontolepis* — oval, slightly flattened on two sides). These cysts are very solid but break and deform during the histochemical processing. Mrázek (1891) was unable to process histologically the cysts of *T. hamanni* due to these properties. Microvilli and cellular layer of subtegument grow in the thickened parts of the cyst wall, whereas the outer circular and longitudinal and inner longitudinal muscle and connective tissue layers of subtegument remain unchanged.

The microvilli on the surface of cysticercoids from *Gammarus* are so conspicuous that they cannot be overlooked. The authors dealing with these cestode larvae (e.g., Mrázek 1891, Prokopič and Groschaft 1961) described them as a "dense array of undulated villi" or "strongly villous layer". The microvilli were not found in the cysticercoids from other hosts.

Some cysts of *T. sumavensis* contain a large number of fine fibres projecting from the narrowed parts of tegument-forming cells radially towards the surface. These fibres could not be distinguished from microvilli in our material by the used methods. The fibres start to form only in the flattened cysts which had already terminated their development. Voge (1960) described analogical fibres running from bottle-shaped cells of the peripheral cyst layer which he found during histological studies of fully developed cysticercoids of *Hymenolepis diminuta* (Rudolphi, 1819). In Ubelaker's (1980) opinion the fibres described by Voge are identical with those described from the same species by Bogitsh (1969), Ubelaker et al. (1970) and Allison et al. (1972) on the basis of electron microscopical observations. The authors described the origin of fibres in perinuclear cytoplasm (corresponding to tegument-forming cells observed by us and Voge's bottle-shaped cells) situated under the outer circular and longitudinal layers of muscle and connective tissue fibres and connected through cytoplasmic processes with distal cytoplasm (corresponding to amorphous substance of tegument in our description). The function of these cells was not discussed. Since we have not managed to find any excretory canals in the cysts of the studied species, we assume that these cells may have an excretory function, all the more that they are connected with the outer surface of the cyst. Another hypothesis is that these are the tegument-forming cells, in the

perinuclear cytoplasm of which fine fibrils are formed as a sign of ageing of the cyst.

The neck in most of the cysticercoids forms a continuous layer on the inner side of cyst cavity after invagination into it. It surrounds the retracted scolex in such a way that the tegument of the neck is turned to that of the scolex and the neck is grown together with the cyst wall only at the site of invagination. Its remaining part freely adheres to the inner side of cyst and is movable like the scolex. Due to the fact that cysticercoids of cestodes of the genera *Coronacanthus* and *Triodontolepis* survive in *Gammarus* for a long time and that the scolex moves intensively in the cyst cavity, the neck is gradually torn off from the cyst wall (Valkounová 1983 — Plate I, Fig. 1; Plate II, Fig. 2) and then lies freely, together with the scolex, within the cyst cavity.

The cells described in the rostellar sacs of cysticercoids of the genera *Coronacanthus* (Valkounová 1983, 1984, 1985) and *Triodontolepis* cannot be unambiguously identified as gland cells on the basis of the obtained results, but it cannot be excluded that myoblasts are involved. They were not described in the literature, though they are very conspicuous on the scolex, particularly if PAS and AB pH 2.6 methods are used. Typical neurosecretory cells were found by us in the anterior part of rostellum and they were strongly fuchsinophilic, fusiform and with long filaments. They stained most markedly with PAA-AF. Cells of the same character were described by Davey and Breckenridge (1967) from *Hymenolepis diminuta* and by Smyth (1964) from *Echinococcus granulosus* (Batsch, 1780).

МОРФОЛОГИЯ И ГИСТОХИМИЯ ЦИСТИЦЕРКОИДОВ ТРЕХ ВИДОВ ЦЕСТОД РОДА *TRIODONTOLEPIS* YAMAGUTI, 1959 (HYMENOLEPIDIDAE)

Й. Валкоунова

Резюме. Цистицеркоиды цестод *T. bifurca* (Hamann, 1891), *T. hamanni* (Mrázek, 1891) и *T. sumavensis* Prokopič, 1957 из полости тела *Gammarus* (*Rivulogammarus*) *fossarum* Koch, 1835 изучали в первый раз с помощью гистологических и гистохимических методов. Размер цист 228—247×156—228 мкм у *T. hamanni*, 282—456×176—267 мкм у *T. bifurca* и 447—586×298—396 мкм у *T. sumavensis*. Хвост развитый, сравнительно длинный и в овальной части дольчатый. Виды отличаются длиной крючков: *T. hamanni* — 15—20 крючков, 26—31 мкм, *T. bifurca* — 10 крючков, 47—64 мкм, *T. sumavensis* — 10 крючков, 72—76 мкм. Цисты овальные или уплощенные. Шейка отрывается от стенки цисты скоро после инвагинации и вместе со сколексом свободно лежит в ее полости. Оплощение цисты причинено односторонним ростом клеточного слоя субтегумента, в котором умножаются мышечные, соединительно-тканевые и аргирофильные волокна. Микроворсинки тегумента цисты, длиной в 1—38 мкм, содержат кислые мукосубстанции с COOH-группами и сульфогруппами. Микротрихи тегумента сколекса и шейки, длиной в 2—4 мкм, содержат нейтральные и кислые (со сульфогруппами) мукосубстанции и белки с тирозином, SH и SS-группами. В крючках хоботка обнаружены белки с SS-группами. В стенках продольных экскреторных каналов сколекса и шейки обнаружены белки с аргинином, тирозином и SH-группами и гидрофильные липиды.

REFERENCES

ALLISON V. F., UBELAKER J. E., COOPER N. B., The fine structure of the cysticercoid of *Hymenolepis diminuta*. The inner wall of the capsule. Z. Parasitenk. 39: 137—147, 1972.

BOGITSH B. J., Fine structural localization

of acid phosphatase and aryl sulphatase activities in the intermediate layer of *Hymenolepis diminuta* cysticercoids. Trans. Am. Microsc. Soc. 88: 411—419, 1969.
DAVEY K. G., BRECKENRIDGE W. R., Neurosecretory cells in a cestode, *Hymenolepis diminuta*. Science 158: 931—932, 1967.
LOJDA Z., Fixation in histochemistry. Folia morphol. 13: 65—83, 1965.
MRÁZEK A., Contribution to the studies of the development of some bird cestodes. Věst. Král. české spol. nauk 13: 79—131, 1891. (In Czech.)
PEARSE A. G. E., Histochemistry theoretical and applied. Vol. 1. Churchill Ltd., London, 759 pp., 1968.
PROKOPIČ J., GROSCHAFT J., Contribution to the knowledge of the life cycle of cestodes from the shrew and notes to their synonymy. Čs. parasitol. 8: 295—304, 1961. (In Czech.)
SMYTH J. D., Observations on the scolex of *Echinococcus granulosus*, with special reference to the occurrence and cytochemistry of secretory cells in the rostellum. Parasitology 54: 515—526, 1964.
UBELAKER J. E., Structure and ultrastructure of the larvae and metacestodes of *Hymenolepis diminuta*. In: H. P. Arai (Ed.), Biology of the tapeworm *Hymenolepis diminuta*, Academic Press, New York—London—Toronto—Sydney—San Francisco, 59 to 156, 1980.
—, COOPER N. B., ALLISON V. F., The fine structure of the cysticercoid of *Hymenolepis diminuta*. I. The outer wall of the capsule. Z. Parasitenk. 34: 258—270, 1970.
VALKOUNOVÁ J., Morphology of the cysticercoid of the tapeworm *Coronacanthus integer* (Hamann, 1891) (Hymenolepididae). Folia parasit. (Praha) 30: 243—247, 1983.
—, Histochemistry of the cysticercoid of *Coronacanthus integer* (Hamann, 1891) (Hymenolepididae). Folia parasit. (Praha) 31: 325—331, 1984.
—, Morphology and histochemistry of the cysticercoid of *Coronacanthus omissus* (Baer et Joyeux, 1943) (Hymenolepididae). Folia parasit. (Praha) 32: 139—143, 1985.
VOGE M., Studies in cysticercoid histology. I. Observations on the fully developed cysticercoid of *Hymenolepis diminuta* (Cestoda: Cyclophyllidea). Proc. Helminthol. Soc. Wash. 27: 32—36, 1960.

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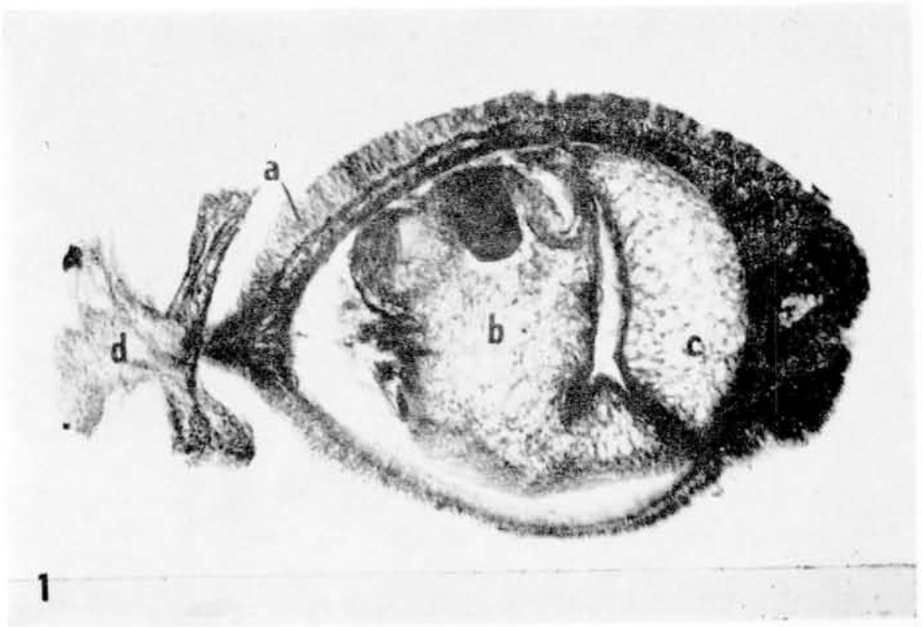
A. I. Gadzhiev: Gamazovye kleshchi Kavkaza. (Gamasoid mites of the Caucasus). *Publ. House Elm, Baku 1983, 178 pp., 27 Tables. Price 1.80 R.*

The publication presents information on materials obtained between 1956 and 1979, including mite collections from about 100,000 mammals, 4,000 birds, 2,000 reptiles, 5,000 nests and burrows, 2,000 soil and 5,000 plant samples. It is divided into 8 parts. The brief survey of hitherto studies on gamasoid mites in the Caucasus is followed by an ecological-faunistical one, in which 350 species, belonging to 77 genera and 21 families, are reported. The subsequent part summarizes findings of Gamasoidea on different species of rodents, bats, insectivores, carnivores, birds and reptiles. The fourth part deals with the distribution of these mites in three natural zones and in ex trazonal regions of the Caucasus. The sub sequent parts are devoted to the influence of the hosts' way of life on the composition of their gamasoid mites, to the specificity and mutual exchange of these parasites, to their zoogeographic peculiarities and medical importance. The text closes with a 10-page list of references. The publication includes a wealth of concrete data, presented in many well-organized tables. It provides a very good information about the fauna of Gamasoidea in the Caucasus and about the general stage of its knowledge.

Dr. V. Černý, C.Sc.



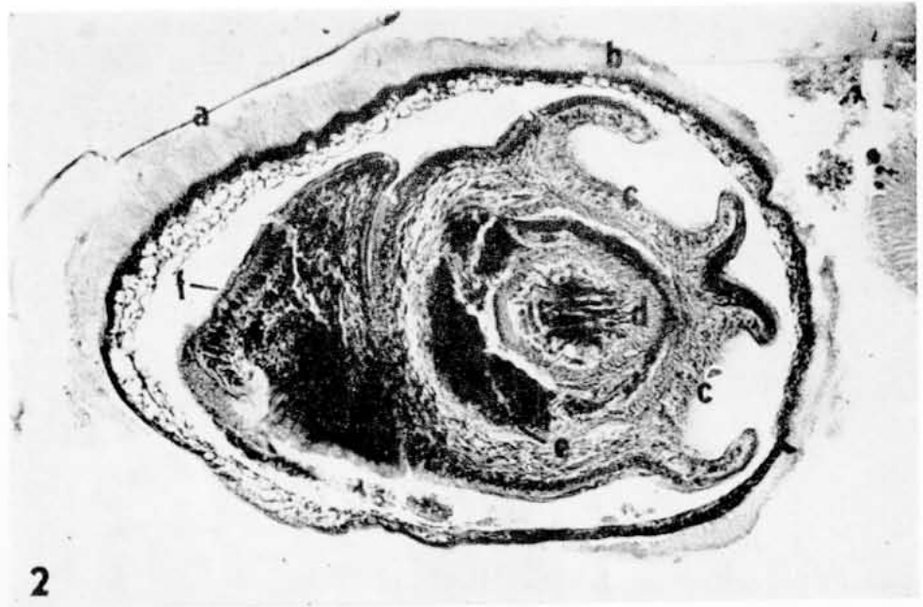
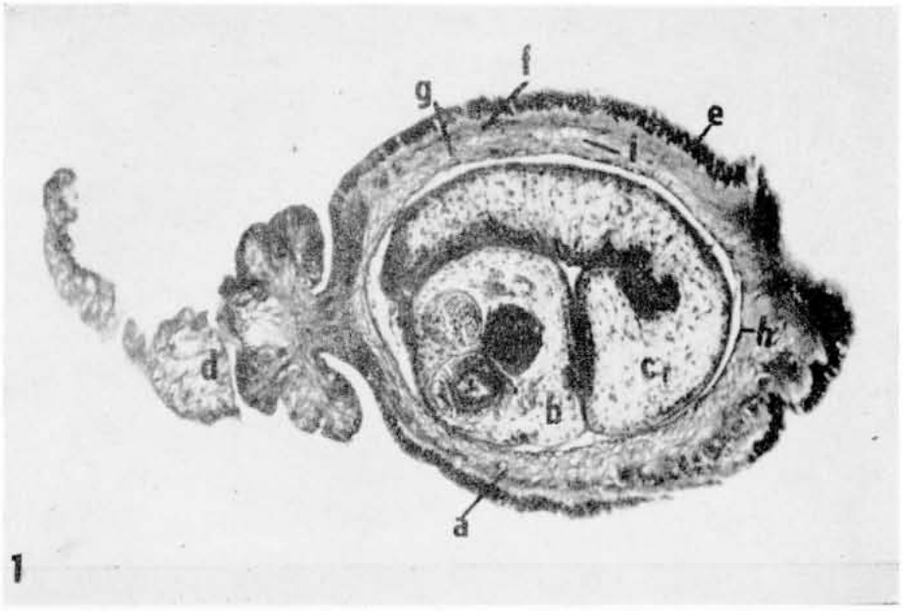


Fig. 1. Cyst of *T. hamanni* with scolex and neck freely lying in its cavity. Cyst (a), scolex (b), neck (c), tail (d). Hale-PAS (× 210). **Fig. 2.** Remnant of thin fibrous envelope (a) on the surface of cyst (b) of *T. sumavensis*. Suckers (c), rostellum (d), cells of rostellar sac (e), neck (f). Van Gieson (× 200).



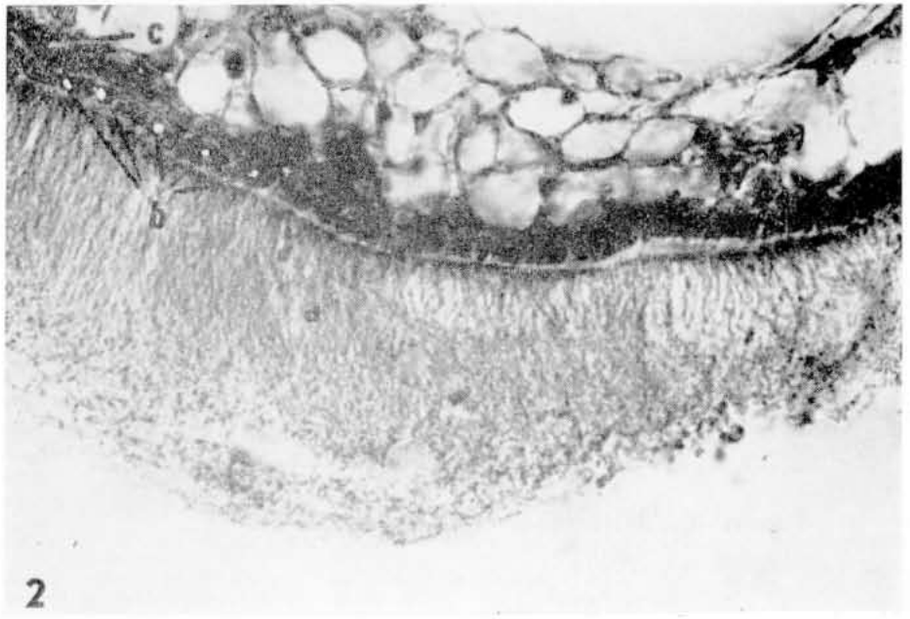
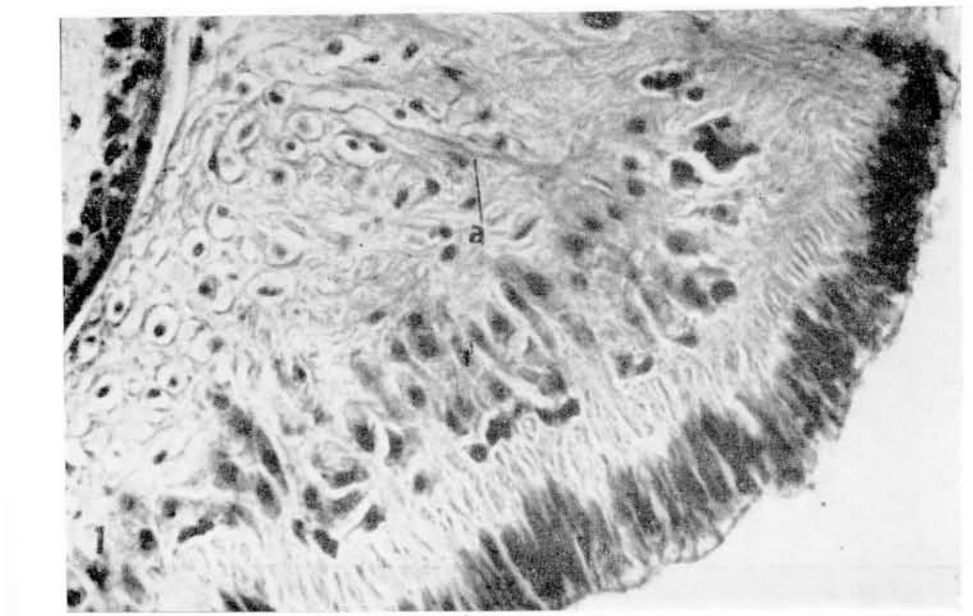


Fig. 1. Cysticercoid of *T. sumavensis*. Cyst (a), scolex (b), neck (c), tail (d), microvilli (e), muscle and connective tissue layer of outer part of subtegument (f), cellular layer of subtegument (g), muscle and connective tissue layer of inner part of subtegument (h), calcareous bodies (i). Gomori (× 170). **Fig. 2.** Wall of cyst of *T. sumavensis*. Microvilli (a), circular muscle and connective tissue layer of outer part of subtegument (b), longitudinal muscle and connective tissue layer of outer part of subtegument (c). Van Gieson (× 1100).



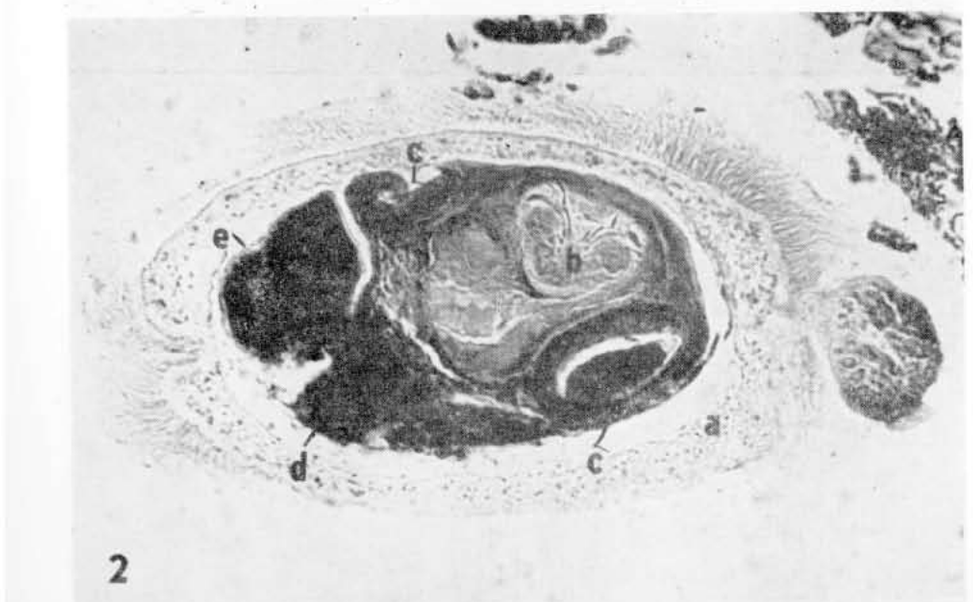


Fig. 1. Wall of cyst of *T. sumavensis* with fine fibres projecting from the cells of subtegument (a). Haematoxyline-eosine (× 800). **Fig. 2.** Glycogen content in the cysticercoid of *T. bifurca*. Cyst (a), rostellum with hooks (b), suckers (c), scolex parenchyma (d), neck (e). Best's carmine (× 320).

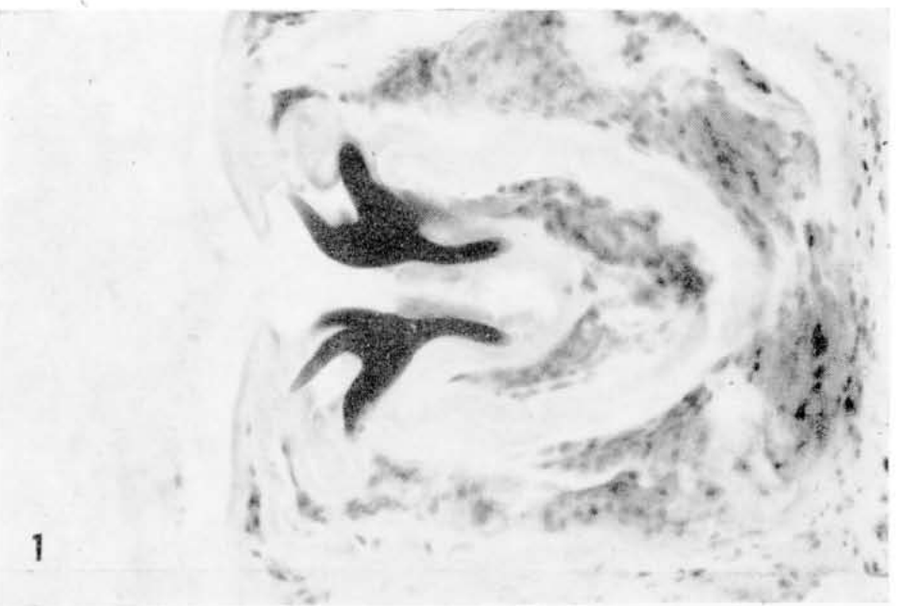


Fig. 1. Hooks of *T. sumavensis*, Kóssa (× 400). **Fig. 2.** Hooks of *T. hamanni*, Sudan black B (× 700).