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**FIRST FINDINGS OF ACANTHOCEPHALANS
ARHYTHMORHYNCHUS INVAGINABILIS,
SOUTHWELLINA HISPIDA (ACANTHOCEPHALES,
POLYMORPHIDAE) *PLAGIORHYNCHUS (PLAGIORHYNCHUS)*
ODHNERI (ACANTHOCEPHALES, PLAGIORHYNCHIDAE)
IN THE INTERMEDIATE HOSTS**

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First Finding of Acanthocephalans *Arhythmorhynchus invaginabilis*, *Southwellina hispida* (Acanthocephales, Polymorphidae), *Plagiorhynchus (Plagiorhynchus) odhneri* (Acanthocephales, Plagiorhynchidae) in the Intermediate Hosts. Lisitsyna O. I. — The acanthocephalan larvae of *Arhythmorhynchus invaginabilis*, *Southwellina hispida*, *Plagiorhynchus (Plagiorhynchus) odhneri*, parasites of waterfowl, were found for the first time in intermediate hosts, amphipods of the family Talitridae. Larvae are described, drawn and photomicrographed.

Key words: Acanthocephala, Talitridae, *Arhythmorhynchus invaginabilis*, *Southwellina hispida*, *Plagiorhynchus (Plagiorhynchus) odhneri*, intermediate hosts, Ukraine.

Первая находка акантоцефалов *Arhythmorhynchus invaginabilis*, *Southwellina hispida* (Acanthocephales, Polymorphidae), *Plagiorhynchus (Plagiorhynchus) odhneri* (Acanthocephales, Plagiorhynchidae) у промежуточных хозяев. Лисицына О. И. — Личинки акантоцефалов трех видов, *Arhythmorhynchus invaginabilis*, *Southwellina hispida*, *Plagiorhynchus (Plagiorhynchus) odhneri*, паразитов водно-болотных птиц, впервые обнаружены у амфипод сем. Talitridae, промежуточных хозяев. Приведены описания, рисунки и фотографии найденных личинок.

Ключевые слова: акантоцефалы, Talitridae, *Arhythmorhynchus invaginabilis*, *Southwellina hispida*, *Plagiorhynchus (Plagiorhynchus) odhneri*, промежуточные хозяева, Украина.

Introduction

Crustaceans from the family Talitridae (Amphipoda) are known to be intermediate hosts of helminths in Eastern Palaearctic (Atrashkevich, 2002). However, helminth larvae were not reported from these invertebrates in Western Palaearctic, particularly in Ukraine.

During the expedition to the Black Sea Biosphere Reserve (Kherson oblast, Yagorlytsky Kut, Tendrovska Spit areas) in August 2010, acanthocephalan larval forms were found in spray zone crustacean *Orchestia* sp. (Amphipoda, Talitridae). Cystacanths of three species, *Arhythmorhynchus invaginabilis* (Linstow, 1902) L'he, 1912, *Southwellina hispida* (Van Cleave, 1925) Witenberg, 1932, and *Plagiorhynchus (Plagiorhynchus) odhneri* Lundström, 1942 were found. Intermediate hosts of *A. invaginabilis* and *P. (Pl.) odhneri* were found for the first time, and *S. hispida* has been previously reported from other groups of crustaceans (Schmidt, 1985).

Herein, we present the illustrated descriptions of larvae found, as well as information on crustaceans' infection.

Material and methods

Totally 811 specimens of crustaceans were examined, and 25 of them (3.08%) contained acanthocephalan larvae in their body cavities. Amphipods were investigated by compressing method using dissection microscope MBS-10. The larvae found were removed from the body of amphipods and placed into saline. Some of them were fixed invaginated, another ones were removed from cysts and placed into cold distilled water (+4 °C) for 10–90 min. After 60–90 minutes in cold water, *A. invaginabilis* cystacanths spontaneously evaginated

presoma with posterior end of the body remained invaginated. Cystacanths of *S. hispida* within 10–30 minutes spontaneously evaginated first posterior end of the body, and then presoma. In cystacanths of *P. (Pl.) odhneri* proboscis was evaginated by compressor method. All larvae were fixed in 70° ethanol and clarified in Fora-Berleze liquid. Drawings were made with using drawing tube RA-7. Photographs were made with using microscope Axio Imager M1.

All measurements in the text are given in millimeters.

Results

Arhythmorhynchus invaginabilis (Linstow, 1902) Lühe, 1912 (fig. 1, *b*; 2, *c*)

Description of cystacanths (1 ♂, 2 ♀). Encysted fusiform larvae, white, with barely noticeable pinkish tinge. Cyst walls thin, transparent. Measurements of larva in cyst 2.52 x 0.62. Measurements of larva without cyst, with invaginated anterior end, including area of spines, and posterior end 1.29 x 0.61. Length of metasoma in cystacanth with evaginated proboscis 2.06–2.28, maximum width 0.60. Proboscis almost cylindrical, little wider in the anterior part and slightly narrowed to the base. Dilatation in the middle of proboscis, characteristic for adult parasites, only outlined in larvae. Length of proboscis 0.65–0.86 with maximum width at the top 0.22–0.23, at the base of neck 0.18–0.19. Asymmetric dilatation in the anterior part of the neck, especially pronounced in adult parasites, just slightly appeared in larvae. Length of neck 0.85–1.02. Proboscis receptacle 1.43–1.77 x 0.16–0.20. In the middle of proboscis receptacle, just above the level of presoma and metasoma connection, elongated cephalic ganglion, 0.18 x 0.03 present. Lemnisci long, thin, beginning in the neck, 0.20–0.42 above spines area and extend into the metasoma, substantially outside the spines area, their length 2.50–3.00 and width 0.04. Proboscis armed with hooks arranged in 24–25 longitudinal rows with 17–20 hooks in a row. First 9 hooks of proboscis are relatively large, with simple roots, directed posteriorly. Tenth–eleventh hooks with reduced roots, and from 12th hook, roots becoming larger with changed shape: front and back processes appearing. The last three hooks in row with only one process directed anteriorly. In middle of proboscis, hooks 9–11 located ventrally, 0.0025–0.005 larger than dorsal ones.

Measurements of hook blades and roots are given in table 1.

Anterior part of metasoma armed with spines, length of band of spines 0.96–1.2. Length of spines area on the ventral and dorsal sides not significantly different. Spines arranged in irregular longitudinal rows, 32–34 at top, and 26–28 at bottom of the spines area. Number of spines in a row variable, 24–28 in female, and 19–20 in male. Length of chitinous spine including part immersed into tegument 0.025.

Posterior end invaginated, long, twisted and occupying substantial part of body cavity. Genitals in their infancy, enclosed in bag of ligament, testes size 0.16 x 0.09–0.10. Vagina with two muscular sphincters. Gonopore terminal in both sexes.

Taxonomic summary

Host: *Orchestia* sp.

Site of infection: body cavity.

Intensity of infection: 1 helminth/host

Prevalence: 0.37%.

Locality: Kherson oblast, Yagorlytsky Kut, Tendrovska Spit areas (46°14'N, 31°38'E).

Southwellina hispida (Van Cleave, 1925) Witenberg, 1932 (fig. 1, *c*; 2, *c*)

Description of cystacanths (2 ♂, 3 ♀). Encysted larvae oval, orange in color, gradually losing their color after fixation. Cysts thin, transparent, with orange tint. Measurements of larva in cyst 2.40 x 0.90. Measurements of larva without cyst 2.16 x 0.88. Length of metasoma in cystacanth with evaginated proboscis and posterior end of body 2.06–2.28,

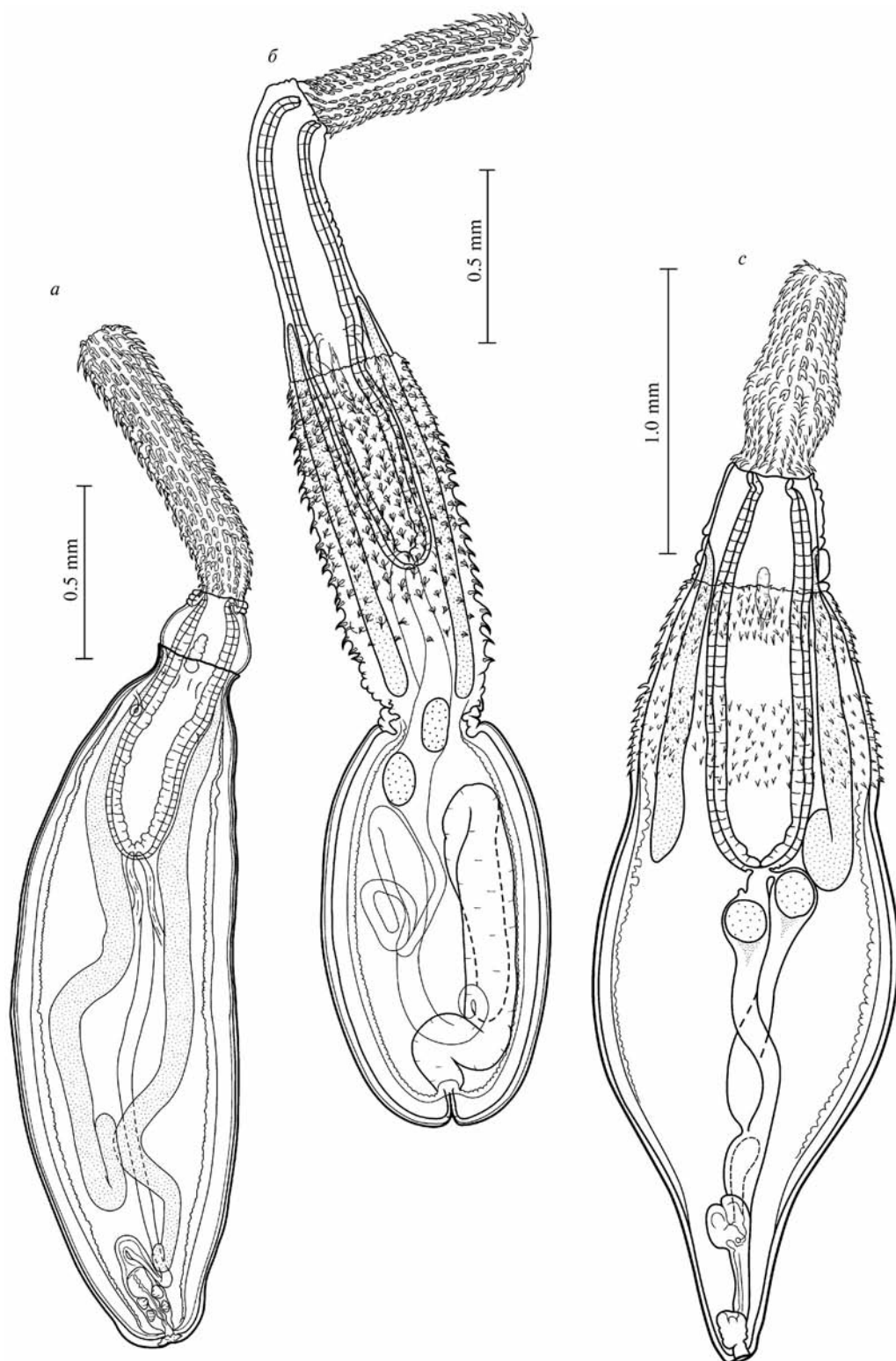


Fig. 1. Cystacanths from the body cavity of *Orchestia* sp.: a — female *Plagiorhynchus odhneri*; b — male *Arhythmorhynchus invaginabilis*; c — male *Southwellina hispida*.

Рис. 1. Цистаканты из полости тела *Orchestia* sp.: a — самка *Plagiorhynchus odhneri*; b — самец *Arhythmorhynchus invaginabilis*; c — самец *Southwellina hispida*.

Table 1. Length of hook blades and roots in found acanthocephalan larvae

Таблица 1. Длина лезвий и корней крючьев обнаруженных личинок акантоцефалов

N	<i>A. invaginabilis</i>		<i>S. hispida</i>				<i>P. (Pl.) odhneri</i>	
	♂, ♀		♂		♀		♂, ♀	
	blades	roots	blades	roots	blades	roots	blades	roots
1	0.038– 0.045	0.020– 0.035	0.040– 0.052	0.025– 0.028	0.045– 0.050	0.040– 0.050	0.043–0.04 5	0.030– 0.038
2	0.040– 0.050	0.033– 0.040	0.048– 0.055	0.033– 0.038	0.051– 0.050	0.050– 0.053	0.045– 0.048	0.040– 0.043
3	0.048– 0.050	0.033– 0.038	0.052– 0.055	0.038– 0.050	0.055– 0.060	0.053– 0.055	0.045– 0.050	0.043
4	0.048– 0.050	0.035– 0.038	0.055– 0.058	0.040– 0.050	0.055– 0.063	0.055	0.045– 0.048	0.043– 0.045
5	0.043– 0.045	0.035– 0.037	0.053– 0.057	0.040– 0.055	0.053– 0.057	0.048– 0.050	0.043– 0.045	0.043– 0.045
6	0.038– 0.045	0.035– 0.038	0.051– 0.057	0.045– 0.050	0.053– 0.058	0.055– 0.060	0.043– 0.045	0.043– 0.048
7	0.033– 0.045	0.033– 0.038	0.048– 0.055	0.050– 0.060	0.053– 0.060	0.065– 0.067	0.040– 0.045	0.043– 0.048
8	0.028– 0.038	0.026– 0.038	0.045– 0.055	0.045– 0.062	0.045– 0.058	0.045– 0.063	0.040– 0.045	0.043– 0.050
9	0.030– 0.035	0.018– 0.033	0.047– 0.053	0.040– 0.055	0.045– 0.053	0.038	0.039– 0.043	0.045– 0.050
10	0.028– 0.033	0.017– 0.020	0.040– 0.051	0.025– 0.040	0.050– 0.058	0.030– 0.038	0.038– 0.040	0.043– 0.050
11	0.027– 0.035	0.015– 0.020	0.040– 0.055	0.028– 0.033	0.050– 0.058	0.030– 0.033	0.038	0.043– 0.050
12	0.030– 0.033	0.017– 0.025	0.043– 0.057	0.030	0.050– 0.060	0.030– 0.035	0.033– 0.038	0.040– 0.045
13	0.033– 0.035	0.020– 0.025	0.050– 0.062	0.028– 0.030	0.050– 0.063	0.028– 0.033	0.030– 0.033	0.038– 0.040
14	0.033– 0.035	0.025– 0.030	0.050– 0.060	0.025	0.050– 0.060	0.030	0.030– 0.033	0.030– 0.035
15	0.033– 0.035	0.020– 0.035	0.048– 0.058	0.025– 0.028	0.050– 0.058	0.028	0.028– 0.030	0.025– 0.030
16	0.018– 0.030	0.018– 0.030	0.045– 0.048	0.025	0.045– 0.060	0.025	0.028– 0.030	0.020– 0.025
17	0.018– 0.028	0.018– 0.028	0.045– 0.048	0.018– 0.025			0.028– 0.030	0.018– 0.022
18	0.018– 0.020	0.018– 0.020					0.028– 0.030	0.013– 0.018
19	0.018– 0.025	0.018– 0.025					0.020– 0.022	0.010– 0.015
20	0.018	0.018						

maximum width 0.82–1.17. Shape of proboscis typical for the species, with dilatation in the middle. Length of proboscis 0.76–0.85 with maximum width 0.26–0.39 in middle. Length of neck 0.49–0.73. Proboscis receptacle with powerful muscle double-layer walls, its length 1.09–1.83 with maximum width 0.29–0.38. In middle of proboscis receptacle, at level of presoma and metasoma connection, elongated cephalic ganglion 0.18 x 0.06 is situated. Lemnisci wide, sometimes with loop-shaped bends, beginning in neck, 0.15–0.25 anterior to spines area and extend into metasoma; their length 1.67–1.70. Proboscis armed with hooks arranged in 19–21 longitudinal rows, with 14–17 hooks in a row. First 8–10 proboscis hooks powerful, with simple roots, directed posteriorly, subsequent roots with processes directed anteriorly. Hooks in females somewhat larger than those in males; their measurements are given separately. Measurements of hook blades and roots are given in table 1.

Anterior part of metasoma armed with spines arranged in two bands. Total length of spine area 0.61–0.72. Distance between bands variable. Spines arranged in irregular

longitudinal rows, 48–54 in anterior band, and 54–60 in bottom one. Number of spines in row variable, 5–6 in anterior band, 6–8 at bottom. Length of chitinous spine including part immersed into tegument 0.018–0.028.

Genitals in their infancy. Two bags of ligament, testes size 0.17–0.20 x 0.10–0.18. Length of female gonoduct 0.88–0.93. Vagina with two muscular sphincters. Gonopore terminal in both sexes.

Taxonomic summary

Host: *Orchestia* sp.

Site of infection: body cavity.

Intensity of infection: 1–2 helminths/host

Prevalence: 1.11%.

Locality: Kherson oblast, Yagorlytsky Kut, Tendrovska Spit areas (46°14'N, 31°38'E).

Plagiorhynchus (Plagiorhynchus) odhneri Lundström, 1942 (fig. 1, *a*; 2, *a*, *b*, *e*, *f*)

Description of cystacanths (1 ♂, 3 ♀). No cysts. Larvae white in color, with smooth metasoma. Invaginated male cystacanths differing from invaginated female cystacanths in shape and size (fig. 2, *a*, *b*). Male cystacanths oval, 1.25 x 0.88 in size. Female cystacanths more elongated, 1.80–1.85 x 0.78–0.87. Length of metasoma in cystacanth with evaginated proboscis 2.06, maximum width in middle 0.66. Proboscis cylindrical, slightly curved towards longitudinal axis of body. Length of proboscis 0.88 with maximum width in middle 0.19. Length of neck 0.20–0.25. Proboscis receptacle 0.78–1.05 x 0.21–0.22. In middle of proboscis receptacle, at level of neck and metasoma connection, elongated cephalic ganglion 0.11–0.12 x 0.02–0.03 present. Lemnisci long, thin, starting at border of presoma and metasoma connection and extended almost to the posterior end of body, curving and twisting. Their size 2.00–2.10 x 0.10–0.11. Proboscis armed with hooks arranged in 20–21 longitudinal rows with 19 hooks in a row. All proboscis hooks have simple roots directed posteriorly. From 13–14th hooks, roots gradually becoming shorter, root of basal hook reduced. Measurements of hook blades and roots are given in table 1.

Genitals partly formed. One bag of ligament present. Testes 0.21–0.25 x 0.020–0.21 in size. Vagina with two muscular sphincters. Gonopore terminal in both sexes. Distal end of body slightly retracted.

In one female with invaginated proboscis, evident teratology in hooks arrangement was observed. In the middle of proboscis, 5–7 hooks in several rows were not directed posteriorly as normal, but anteriorly (fig. 2, *e*, *f*). The larva was found alive, and according to its structure, morphology of hooks and their roots it undoubtedly belongs to *P. (Pl.) odhneri*. Cases of teratology in position of proboscis hooks in acanthocephalans are rather common. We have repeatedly observed some basal or apical hooks in the counter direction or falling out of the general formula both in cystacanths and adults acanthocephalans of various groups. In the middle of proboscis, such deviations were observed for the first time.

Taxonomic summary

Host: *Orchestia* sp.

Site of infection: body cavity.

Intensity of infection: 1 helminth/host.

Prevalence: 0.62%.

Locality: Kherson oblast, Yagorlytsky Kut, Tendrovska Spit areas (46°14'N, 31°38'E).



Fig. 2. Photographs of cystacanths from the body cavity of *Orchestia* sp.: a — *Plagiorhynchus odhneri*, ♂; b — *Plagiorhynchus odhneri*, ♀; c — *Southwellina hispida*; d — *Arhythmorhynchus invaginabilis*; e, f — case of teratism in the structure of hooks in *Plagiorhynchus odhneri*.

Рис. 2. Фотографии цистакантов из полости тела *Orchestia* sp.: a — *Plagiorhynchus odhneri*, ♂; b — *Plagiorhynchus odhneri*, ♀; c — *Southwellina hispida*; d — *Arhythmorhynchus invaginabilis*; e, f — случай уродства в строении крючков *Plagiorhynchus odhneri*.

Discussion

Arhythmorhynchus invaginabilis is a common parasite of sandpipers and gulls on sea coasts of the Palaearctic European part, less common in the Eastern Palaearctic (Khokhlova, 1986; Belopolskaya, 1983; Lisitsyna, 2008; Atrashkevich, Sonin, 2010).

Intermediate hosts have not yet been known. Larvae of other species from genus *Arhythmorhynchus* were found in amphipods from family Talitridae: *A. capellae* in *Traskorchestia ochotensis* on the Shantar Islands (Tsimbalyuk, Kulikov, Tsimbalyuk, 1979); *A. teres* in *Traskorchestia ochotensis* in the basin of the Okhotsk Sea, and *Platorchestia crassicornis* on Kunashir island (Atrashkevich, 2002, 2009); *Arhythmorhynchus* sp. in *Platorchestia crassicornis* and *Dogielinotus moskvitini* on Sakhalin and the Kuril Islands (Atrashkevich, 2009); and also in other crustaceans — *A. petrochenkoi* in *Asellus* spp. (Isopoda: Asellidae) in Chukot (Atrashkevich, 1975, 1981, 1997, 2001; Atrashkevich, Sonin, 2010); *A. frassoni* in shrimp *Palaemon squilla* (Decapoda: Palaemonidae) in South America (Travassos, 1926; Golvan, 1961) and in crab *Uca rapax* (Decapoda: Ocypodidae) in Florida (Nickol, Heard, Smith, 2002); *A. teres* in amphipod *Eugammarus tiuschovi* (Amphipoda: Gammaridae) in the Northern Okhotsk Sea (Atrashkevich, 2002).

S. hispida, a common parasite of ciconiiform birds, is widespread from Japan to North America (Schmidt, 1973; Khokhlova, 1986; Lisitsyna, 2008). Previously, only Decapoda have been reported as intermediate hosts of *Southwellina*. Intermediate host of *S. hispida* is shrimp *Macrobrachium* sp. (Decapoda: Palaemonidae) (Schmidt, 1985). Larvae of other species of this genus, *S. dimorpha*, were found in crayfishes *Procambarus clarkii* and *Cambarellus shufeldtii* (Decapoda: Cambaridae) in Louisiana (Schmidt, Kuntz, 1967; Schmidt, 1973; Lantz, 1974; Richardson, Font, 2006). Polimorfid cystacanths recorded in Mexico in crabs *Gecarcinus planatus* (Decapoda: Gecarcinidae) (Perez-Chi, Sanchez-Manzano, 2001) were previously placed by these authors to the genus *Arhythmorhynchus*. The above photo suggests that this is cystacanth from the genus *Southwellina*. Herein, we report the first finding of *S. hispida* cystacanths in amphipods from the family Talitridae.

P. (Pl.) odhneri was described from oystercatcher (*Haematopus ostralegus* L.) in Sweden (Lundström, 1942), and is also known in birds from the order Charadriiformes from Britain (Dimitrova, 2009) and the Black Sea coast (Lisitsyna, 1992). Intermediate hosts have not yet been known. Species of the subgenus *Prosthorhynchus* (the genus *Plagiorhynchus*) use terrestrial isopodes (Isopoda: Oniscoidea) as intermediate hosts (Sinitzin, 1929; Schmidt, Olssen, 1964; Dimitrova, 2009; other studies). Till now, intermediate hosts were not known for any species of the nominal subgenus of genus *Plagiorhynchus*.

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