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H. D. Srivastava Commem. Vol., pp. 109-115.

STUDIES ON THE HELMINTH FAUNA OF ALASKA. XLV.  
*SCHISTOTAENIA SRIVASTAVAI* N. SP. (CESTODA: AMABILIIDAE)  
FROM THE RED-NECKED GREBE, *PODICEPS GRISEGENA* (BODDAERT)

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The genus *Schistotaenia* Cohn, 1900, at present includes six species, all parasites of grebes (Podicipediformes). Among helminths found in a red-necked grebe, *Podiceps grisegena* (Boddaert), on 18 October 1966, at Anchorage, Alaska, were cestodes representing two species of *Schistotaenia*, of which one is described here as new. The host was an adult bird which evidently had been injured during migration.

Twenty-two specimens of the hitherto undescribed cestode were found in this grebe, along with three cestodes identified as *Schistotaenia colymba* Schell, 1955. Also available for comparison were 28 specimens of *S. colymba* from a horned grebe, *Podiceps auritus* (Linnaeus), collected by me in the Nelchina region of south-central Alaska on 19 September 1961, as well as total preparations and sections of cotype specimens of *S. macrocirrus* Chandler, 1948, and paratype specimens of *S. tenuicirrus* Chandler, 1948, from pied-billed grebes, *Podilymbus podiceps* (Linnaeus), from the east-central United States.

The cestodes were stained in Ehrlich's acid hematoxylin or Semichon's acetic carmine. Sections were prepared by the paraffin embedding method and stained in hematoxylin-eosin.

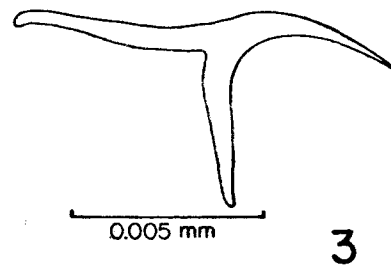
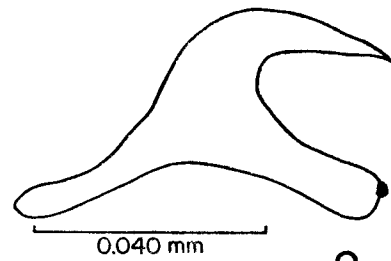
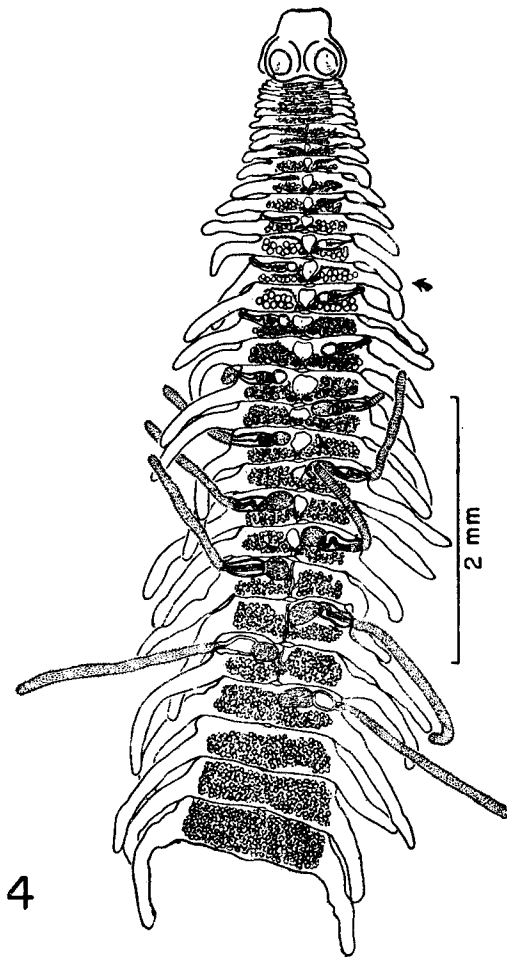
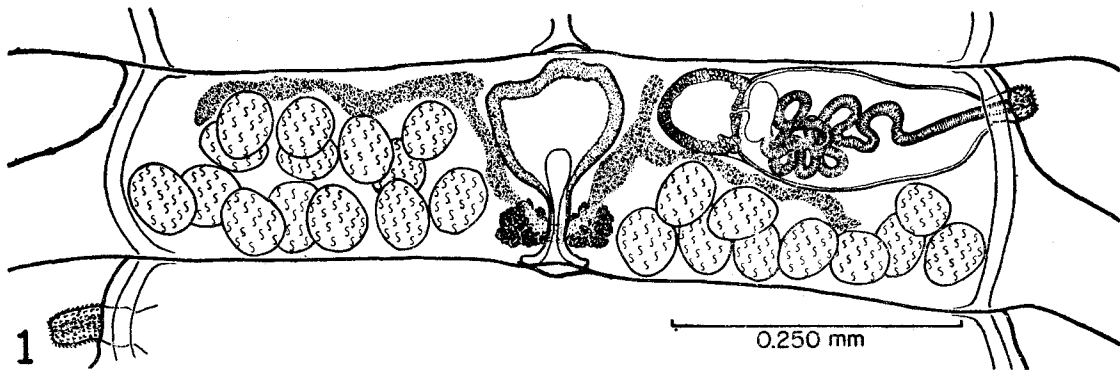
This cestode is named in honor of Dr. H. D. Srivastava, in recognition of his significant contributions to helminthological research.

***Schistotaenia srivastavai* n. sp.**

(Figs. 1-4)

(All measurements in millimeters)

Diagnosis: Strobila 6 to 8 mm long, comprising 32 to 35 segments all wider than long, with length/width ratio increasing posteriad. Margins of segments extended, forming somewhat attenuated, bilateral processes which increase gradually in length from level of first discrete segments to near middle of strobila, where full development attained. Differential growth of anterior part of segment causes gradual shift posteriad in position of lateral processes, their origin being restricted to posterior half of segmental margin in mature and post-mature segments. Fully developed lateral processes 0.850 to 1.050 long by about 0.180 at base and 0.070 at tip. Lateral processes project perpendicular to long axis of strobila in anteriormost segments, thereafter projecting posteriad. Excluding lateral processes, mature segments about 0.720 wide by 0.144 to 0.200 long, with length greater on



poral side. Gravid segments up to 1.25 wide by 0.430 long. Scolex relatively large, 0.580 to 0.685 wide. Suckers, lined by minute spines, about 0.220 in diameter. Stout rostellum, about 0.433 long by 0.180 to 0.230 wide when everted, armed with single row of 22 to 25 hooks 0.062 to 0.070 long; rostellar base covered by spines about 0.005 long and bifurcate proximally. Glandular cells present at base and in apex of rostellum. Unsegmented neck to 0.150 in length. Genital *Anlagen* (seminal receptacle and cirrus sac) visible in first discrete segments. Genital pores regularly alternate, situated at anterior edge of segmental margin. Elongate cirrus sac situated transversely in anterior part of segment and extending across  $2/5$  to  $1/3$  of width of mature segments. Cirrus sac 0.212 to 0.260 long by 0.074 to 0.106 in greatest diameter in mature segments; in early gravid segments, cirrus sac attains maximum length of 0.270 to 0.315. Cirrus sac not present in later gravid segments. Cirrus spinose throughout; spines about 0.010 long and bifurcate proximally. Fully extruded cirrus about 1.5 long by 0.055 in diameter. Accessory vesicles not observed on cirrus sac. External seminal vesicle subspherical in mature segments, 0.070 to 0.076 in diameter with walls 0.010 to 0.018 thick, situated at proximal end of cirrus sac; vesicle enlarges in post-mature and gravid segments, attaining maximum diameter of 0.222 to 0.240. Prostatic vesicle not prominent. Subspherical testes, about 24 in number, the poral side of segment with one or two less than antiporal, extend dorsally across segment to respective ventral longitudinal excretory canals; testes 0.046 to 0.063 in diameter in mature segments, with maximum diameter of 0.085 attained in post-mature segments. Seminal receptacle median, irregularly shaped, extending through entire length of mature segment; size increases posteriad, and subspherical shape gradually assumed. Seminal receptacle frequently distorted on poral side by pressure of adjacent external seminal vesicle. Transverse openings to seminal receptacle, 0.040 to 0.092 in greatest diameter, situated on mid-line at posterior margin of segment on both ventral and dorsal surfaces; intersegmental connections between receptacles not observed. Within each segment, funnel-shaped duct, apparently common, extends anteriad into seminal receptacle from pores. Lobed vitelline gland, about 0.100 wide in mature segments, situated ventrally at posterior margin of segment and dorsal to base of and partially surrounding seminal receptacle. Bilobed ovary transverse, arising near base of seminal receptacle, first extending anteriad, then laterad nearly to ventral longitudinal excretory canals. Uterus appears ventrally in post-mature segments, gradually enlarging to occupy entire segment within limits of ventral longitudinal excretory canals. Anterior and posterior margins of gravid uterus lobed in post-mature segments, but not in fully gravid segments. Eggs subspherical to spherical, 0.031 to 0.037 in diameter; embryo 0.018 to 0.020 in diameter.

*Type host* : Red-necked grebe, *Podiceps grisegena holboellii* Reinhardt.

*Type locality* : Anchorage, Alaska.

*Habitat* : Small intestine of host.

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*Schistotaenia srivastavai* n. sp.

Fig. 1. Mature segment of *S. srivastavai* n. sp., ventral view. Fig. 2. Rostellar hook. Fig. 3. Spine from cirrus. Fig. 4. Entire specimen of *S. srivastavai* n. sp., dorsal view. Arrow indicates segment shown in Figure 1.

*Type* : Slides containing a type and paratype specimens have been deposited in the Helminthological Collection of the U. S. National Museum, Nos. 63135 and 63136.

*S. srivastavai* is characterized by the small size of the strobila, by the small hooks, and by the relatively large cirrus sac. These and other morphological characteristics serve to distinguish it from the six previously described species of *Schistotaenia*.

*S. macrorhyncha* (Rudolphi, 1810) is a much larger cestode, having a strobila up to 45 mm long (Dubinina, 1953), with larger hooks, 0.135 to 0.162 mm long (Baer, 1940; Dubinina, 1953), and a cirrus sac both relatively and absolutely smaller (0.144 to 0.158 mm). The genital pores of *S. macrorhyncha* alternate irregularly, and its egg, 0.064 mm in diameter (Dubinina, 1953), is larger than that of *S. srivastavai*.

*S. scolopendra* (Diesing, 1850) has a strobila only slightly larger than that of *S. srivastavai*, being 7 to 11 mm long (Baer, 1940). The former has larger hooks (0.150 to 0.154 mm long), the cirrus sac is relatively much smaller (see Baer, 1940, fig. 34), and the genital pores alternate irregularly.

*S. macrocirrus* Chandler, 1948, has a slightly longer strobila (11 to 14 mm) of greater width (5 mm), larger hooks (0.125 to 0.130 mm), irregularly alternating genital pores, more numerous testes (46 to 50), a longer cirrus (as much as 3.5 mm), and larger eggs (0.050 to 0.055 mm).

*S. tenuicirrus* Chandler, 1948, has a longer (20 to 30 mm), comparatively narrow strobila, larger hooks (0.135 to 0.142 mm), irregularly alternating genital pores, and more numerous testes (44 to 46).

*S. colymba* Schell, 1955, and *S. srivastavai* are the only members of the genus in which the genital pores alternate regularly. *S. colymba* has a longer (up to 46 mm) comparatively narrow strobila, larger hooks (0.108 to 0.110 mm) (in my material, hooks ranged in length from 0.096, in material from the horned grebe, to 0.111 mm, in material from the red-necked grebe), and more numerous testes (48 to 52). The uterus of *S. colymba*, in post-mature segments, forms two well defined, apparently disjunct, lateral masses which coalesce to fill the gravid segment, whereas the early uterus of *S. srivastavai* is continuous across the segment, ventral to the seminal receptacle. The egg of *S. colymba* is slightly smaller (0.026 to 0.027 mm) than that of *S. srivastavai* [the dimensions given by Schell (1955, p. 350) for the egg were of the embryo only].

*S. indica* Johri, 1959, has a larger strobila (16 to 30 mm), very large hooks (0.130 to 0.170 mm) of different shape, irregularly alternating genital pores, more numerous testes (30 to 34), and a larger egg (0.052 to 0.056 mm).

Study of specimens representing the four species recorded in North America (*S. macrocirrus*, *S. tenuicirrus*, *S. colymba*, and *S. srivastavai*) indicates that shape of strobila and form of the lateral segmental processes may be diagnostic. The strobila of *S. macrocirrus* is relatively wide, with greatest width attained just posterior to the scolex; the lateral processes become progressively shorter and are lacking on gravid segments. *S. tenuicirrus* has parallel margins, with relatively short (ca. 0.430 mm) lateral processes of more or less

uniform length throughout the anterior 2/3 of the strobila, thereafter decreasing in length and in gravid segments not present. The strobilar margins of *S. colymba* are also essentially parallel; the lateral processes, slightly exceeding 1 mm in length, are widest, appearing somewhat inflated, at the base, then taper to a rounded tip. Posteriad they decrease gradually in length, becoming truncate in the posterior half of the strobila; lateral processes of gravid segments measure about 0.5 mm in both length and width and are markedly truncate. In some specimens, the lateral processes on terminal gravid segments were represented only by small, rather pointed projections. The strobila of *S. srivastavai* is cuneiform, with a gradual increase in length of the lateral processes posteriad. Reaching maximum development near the middle of the strobila, these processes thereafter do not decrease in length; terminal gravid segments therefore closely resemble those of *Tatria* spp. In all of the aforementioned four species, the lateral processes are directed posteriad. Schell (1955, p. 347) suggested that the lateral processes are contractile. That this is their characteristic was not evident in *S. srivastavai* nor in representatives of other species examined in the present study, although it was apparent that the form of such processes may be modified by differences in methods of relaxing and fixing the cestodes.

#### DISCUSSION

Fuhrmann (1907) observed in *S. macrorhyncha* and *S. scolopendra* dorso-ventral openings between the two pores situated on the respective surfaces of each segment. Such openings are present in *S. srivastavai*, but their relationship to the seminal receptacle is not clear; evidently both ventral and dorsal pores communicate with the base of a funnel-shaped structure extending anteriorly from near the posterior margin of the segment into the seminal receptacle, and through which the cirrus enters the latter organ. I could not confirm that the seminal receptacula communicate between mature segments, as has been reported for other species (Baer, 1940; Chandler, 1948; Schell, 1955; Johri, 1959). In serial sections of specimens of *S. srivastavai*, no openings were apparent in the thick (ca. 0.018 mm) anterior wall of the seminal receptacle. In gravid segments, however, a narrow, thin-walled tube, an apparent vestige of the seminal receptacle, extends dorsally through the full length of the segment on the mid-line and seems clearly to pass from one dorsal pore to the next.

The occasional finding of the remains of the cirrus sac and the external seminal vesicle in gravid segments may indicate that these organs are resorbed, rather than being extruded or torn out, as suggested by Chandler (1948).

The type host of *S. macrorhyncha* is the little grebe, *Podiceps ruficollis* (Pallas). The cestode has been recorded in Eurasia also from *P. nigricollis* Brehm, and from the holarctic species, *P. auritus* (L.) and *P. grisegena* (Boddaert) (Dubinina, 1953; Sultanov, 1963). Baer (1940) identified this cestode from a South African grebe, *P. capensis* Bp. *S. indica* was described from *P. ruficollis* in India. Described from a South American grebe, *P. dominicus* (L.), *S. scolopendra* has been recorded from the pied-billed grebe, *Podilymbus podiceps* (L.) in Antigua (Baer, 1940). The latter is type host of both *S. macrocirrus* and *S. tenuicirrus*, known thus far only from the east-central United States. The horned grebe, *Podiceps auritus*, is the

type host of *S. colymba*. That *S. tenuicirrus* and *S. colymba* are indigenous in North America is indicated by the finding of the former in a young (downy) pied-billed grebe at Pte. Mouillie, Michigan (see Chandler, 1948), and by the occurrence of the latter in an immature (young of the year) horned grebe collected at Tonsina Lake, south-central Alaska.

The only mixed infection, involving two species of *Schistotaenia*, recorded is that in the red-necked grebe from Anchorage. Data on the occurrence of *Schistotaenia* spp. in grebes examined by me in North America are summarized in Table 1.

Cestodes of the genus *Schistotaenia* embed the rostellum deeply in the intestinal wall of the host, making difficult their removal without loss of the rostellar hooks. Baer (1940) found that the rostellum of *S. scolopendra* penetrated to the muscularis externa, where the hooks were embedded. Sections of the rostellum of *S. srivastavai*, fixed *in situ*, disclosed that the hooks were embedded in the muscularis mucosa (Fig. 5). The tissue reaction was limited to leukocytic infiltration immediately around the rostellum and in the adjacent submucosa.

The finding of a specimen of *S. tenuicirrus* in a common crow, *Corvus brachyrhynchos* Brehm, in central Ohio (see Chandler, 1948), suggests that the apparent specificity of these cestodes for grebes may be ecologic, related to their specialized feeding habits, rather than phylogenetic.

TABLE 1

Some data on the occurrence of *Schistotaenia* in grebes in North America.

Host	Number Examined	Species of <i>Schistotaenia</i> recorded			
		<i>tenuicirrus</i>	<i>macrocirrus</i>	<i>colymba</i>	<i>srivastavai</i>
EAST-CENTRAL NORTH AMERICA :					
<i>Podilymbus podiceps</i> (L.)	15	4	1	..	..
<i>Podiceps auritus</i> (L.)	2	1	..	..	..
<i>Aechmophorus occidentalis</i> (Lawrence)	3	..	..	..	..
ALASKA :					
<i>Podiceps auritus</i> (L.)	6	..	..	1	..
<i>Podiceps grisegena</i> (Boddaert)	23	..	..	1	1

## ACKNOWLEDGEMENT

The undescribed cestode was found in a grebe kindly made available by Mrs. Grace D. Hilliard. At the Arctic Health Research Laboratory, the tissue sections were

Fig. 5. (facing page) Photomicrograph of the rostellum of *Schistotaenia srivastavai* n. sp., *in situ*, in intestinal wall of the red-necked grebe. Cut at 0.010 mm; hematoxylin-eosin.

Robert L. Rausch  
(*Opposite p. 114*)



Plate I



*Schistotaenia srivastavai* n. sp.

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prepared by Mr. L. M. Shults ; photographic assistance was rendered by Mr. G. C. Kelley ; the figures were drawn by Mrs. V. R. Rausch. To these persons I express my thanks.

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