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STUDIES ON CERCARIAE FROM KUWAIT BAY. I. DESCRIPTION AND SURFACE TOPOGRAPHY OF *CERCARIA KUWAITAE* I N. SP. (DIGENEA: CYATHOCOTYLIDAE)

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ABSTRACT: A new cyathocotylid cercaria, *Cercaria kuwaitae* I n. sp., was found in the mud snail *Cerithidea cingulata* in Kuwait Bay. Details are presented on the morphology and behaviour of the cercaria. *C. kuwaitae* I n. sp. differs from known cyathocotylid cercariae in the trifurcate anterior branching of the lateral excretory tubules and in the presence of islets in the caudal tubule. The surface topography of the cercaria and its daughter sporocyst is examined by scanning electron microscopy. The topographical features observed are correlated with the finding and infecting of the second intermediate host.

KEY WORDS: Trematoda, Cyathocotylidae, *Cercaria kuwaitae* I n. sp., cercaria, sporocyst, surface topography, Gastropoda, Prosobranchiata, *Cerithidea cingulata*, Kuwait.

INTRODUCTION

Studies of larval trematodes in molluscs have contributed to our understanding of the complex life-cycles and the systematics of trematodes. The molluscan faunas of Kuwait Bay are well documented (GLAYZER, GLAYZER & SMYTHE, 1984), but their involvement in the transmission of trematodes has not been investigated.

This study is the first in a series on the larval stages of digenetic trematodes in molluscs in Kuwait Bay. It is devoted to the description of a new cyathocotylid cercaria, *Cercaria kuwaitae* I n. sp., from the prosobranch gastropod *Cerithidea cingulata* in Kuwait Bay. The surface topography of the cercaria and its daughter sporocyst was examined by scanning electron microscopy (SEM).

MATERIAL AND METHODS

Individuals of the prosobranch gastropod, *C. cingulata*, naturally infected with trematode larvae, were collected from the mudflats along the southern shores of Kuwait Bay, approximately 10 km west of Kuwait City. Larval stages were studied alive and fixed in AFA and stained in either acetic alum carmine or Ehrlich's hematoxylin. Vital staining with neutral red aided examination of cercarial features. For measurement, larval stages were pipetted into near boiling AFA and then drawn with the aid of a camera lucida. All measurements are given in micrometers with averages in parentheses. The cercaria described in this study is not named but instead designated by locality and number, following the system adopted by CABLE (1956) from SEWELL (1922).

For SEM, living cercariae and daughter sporocysts were fixed in 2,0% glutaraldehyde in 0,1 M sodium cacodylate buffer pH 7,2 for 1 h at 4° C. Following the appropriate buffer wash, the specimens were post fixed in 1% osmium tetroxide in the same buffer for 10 min at 4° C and dehydrated in a graded series of anhydrous acetone. Specimens suspended in acetone were dried in a Technics critical point drying apparatus, coated with gold-palladium and examined in a Jeol JSM-840 scanning electron microscope.

RESULTS

Cercaria kuwaitae I n. sp.

Type host: *Cerithidea cingulata* (Gmelin 1790) (Gastropoda: Prosobranchiata).
Site of infection: Branchial region.
Infection rate: 2,0%, out of 1748 snails.
Type locality: Shuwaikh, Kuwait Bay, Kuwait.
Date of collection: February to May, 1986 and 1992.
Specimens deposited: The helminth collection of the Department of Zoology, University of Kuwait.

Description

Cercaria: Longifurcous pharyngeate cercaria of the cyathocotylid type (Fig. 1, 2). Body flattened dorsoventrally, elongate ellipse, concave ventrally, 340,0-470,0 (400,5) long, 150,0-190,0 (174,0) in maximum width. Surface of body and tail with small, sharp spines, more prominent anteriorly. Sides of body with papillae, each with a short seta; two longer setae at anterior end. Cystogenous cells extend full length of body, in two rows in the anterior half of the body, reduced to one row in the posterior half. Additional 4 pairs situated along the middle anterior region of the body. Penetration glands eleven pairs, in 3 rows (3+4+4), the first two rows within oral sucker, the last row posterior to oral sucker. Penetration glands ducts opening symmetrically around mouth. Oral sucker elliptical, 62,5-75,0 (71,0) long, 42,5-62,5 (56,5) wide; oral cavity tubular. Ventral sucker embryonic, 17,5-22,5 (20,5) in diameter, situated about 227,5-280,0 (252,0) from anterior end of body. Prepharynx short, pharynx 17,5-22,5 (19,6) in diameter, oesophagus short; ceca wide, sinuous, empty, flanking genital primordium posteriorly.

Tail attached dorsally, with Islet of Cort at base; stem 320,0-460,0 (357,0) long, 46,3-67,5 (60,9) wide, with obli-

que muscle bands, aggregation of nuclei of longitudinal muscle fibres along the sides. Caudal bodies absent. Tail stem with numerous long setae set in papillae. Furcae 230,0-300,0 (261,5) long, 25,0-40,0 (33,3) wide at base; fin finely folded, extending along dorsal and ventral edges of each furca, continuous around tip. Numerous short setae cover inner surface of the furcae with only a single row on the posterior margin of the fins. Excretory system typical of cyathocotylid larvae. Fine concretions in excretory vesicle, medial tubules, and cross-commissures. Anterior extension of lateral tubes at commissure junction trifurcate. Caudal excretory tubule forms two islets. Excretory formula $2[(3+3+3)+(3+3+3)]=36$ flame cells, with posterior group extensive in tail stem. Excretory pores near tips of furcae.

The cercaria does not show phototropism. It swims by sudden jerky movement, tail first, taking a zig-zag or spiral path to the surface, and then rests with the furcae spread and the distal half of the tail stem bent at an obtuse angle to the body axis. Downward sinking is entirely passive, landing on the anterior end. On the bottom, furcae are relaxed and the cercaria shows creeping movements with the oral end before swimming up again.

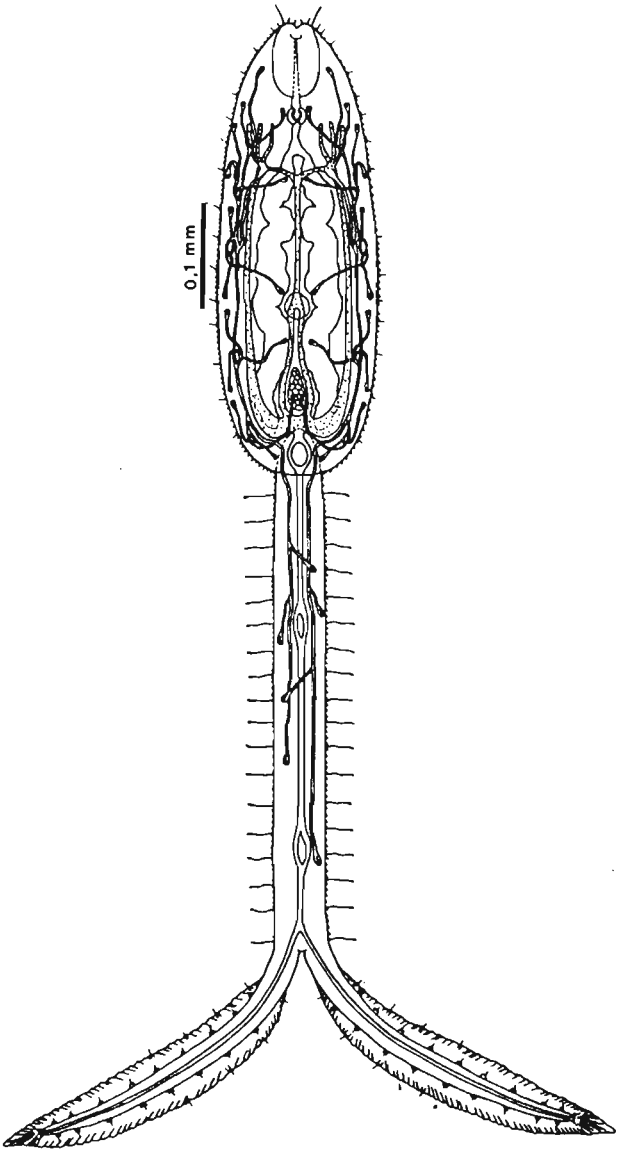

Fig. 1.— *Cercaria kuwaitae* I: ventral view of the cercaria showing excretory system.

Daughter sporocyst: Description based on 10 specimens. Body elongate, motile, with prominent circular muscle bands. Anterior end pointed, posterior end rounded, 4030,0-7670,0 (5649,8) long, 520,0-650,0 (587,6) wide at midbody. Birth pore subterminal. Number of mature cercariae 53-81.

Surface topography

Cercaria: The cercaria comprises three clearly defined regions, vis. elongate ellipse body bearing oral and vestigial ventral suckers, cylindrical tail stem and finned tail furcae (Fig. 3A). The body surface, apart from centre of the ventro-posterior concavity (Fig. 3C), is provided with simple pointed spines (Fig. 3B, 3C, 3D). Spines surrounding the anterior region of the body (Fig. 3B) and on ventro-lateral aspects (Fig. 3D) are larger than on other regions. The tegument of all three regions of the cercaria bears conspicuous transverse ridges (Fig. 3C, 4A, 4B). The oral sucker is surrounded by uniciliated presumed sensory endings and penetration gland openings. Two hemispherical papillae occur on the posterior rim of the sucker (Fig. 3B). Ventro-lateral aspect of the body lined with uniciliated sensory endings and openings of cystogenous cells (Fig. 3D). The tail stem is covered with small spines and supplied with rows of long ciliated sensory endings (Fig. 4A). The tail furcae are devoid of spines and only the internal surfaces of the furcae and fins are supplied with sensory endings (Fig. 4B, 4C, 4D).

Daughter sporocyst: SEM observations of the daughter sporocyst showed an elongate body with a pointed anterior and blunt posterior ends (Fig. 5A). The slit-like birth pore opens subterminally on the anterior end (Fig. 5B). Ciliated sensory papillae are concentrated on the anterior region of the sporocyst (Fig. 5B). The body surface bears circular muscle bands and tegumental folds (Fig. 5C). Dense arrays of microvilli-like structures cover the tegumental folds (Fig. 5D).

DISCUSSION

The general morphological characteristics of *C. kuwaitae* I are identical to CABLE's (1956) description of cercariae of the family Cyathocotylidae Poche, 1926. Cyathocotylid cercariae are widely distributed in freshwater and marine prosobranch gastropods (ANDERSON, 1944; ANDERSON & CABLE, 1950 ; CABLE, 1938, 1963; GOODMAN, 1951; HOLLIMAN, 1961; ITO, 1956,

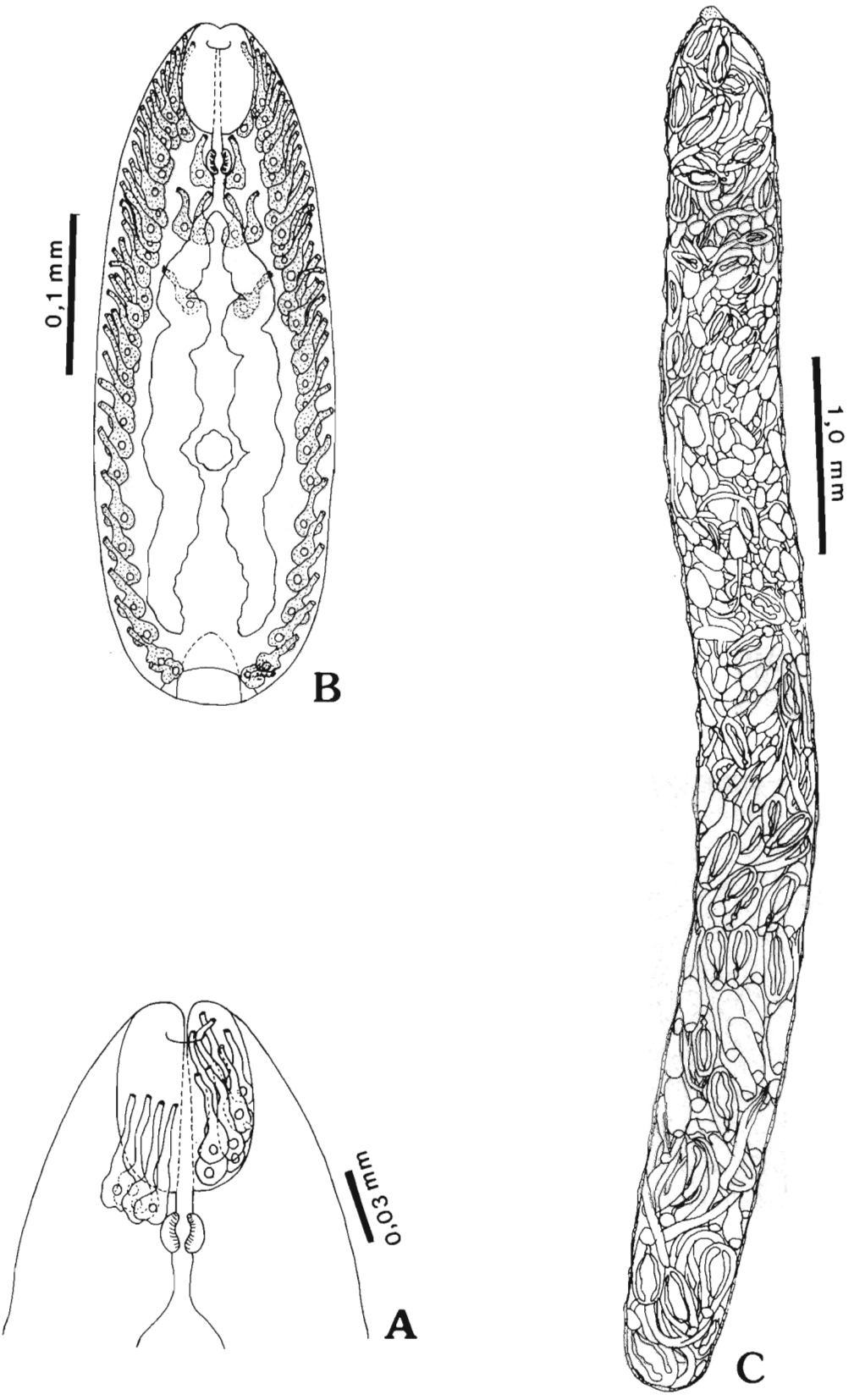

Fig. 2.— *Cercaria kuwaitae* I: A) ventral view of anterior end of the cercaria showing arrangement of penetration glands; B) ventral view of cercarial body showing distribution of cystogenous cells; C) mature daughter sporocyst.

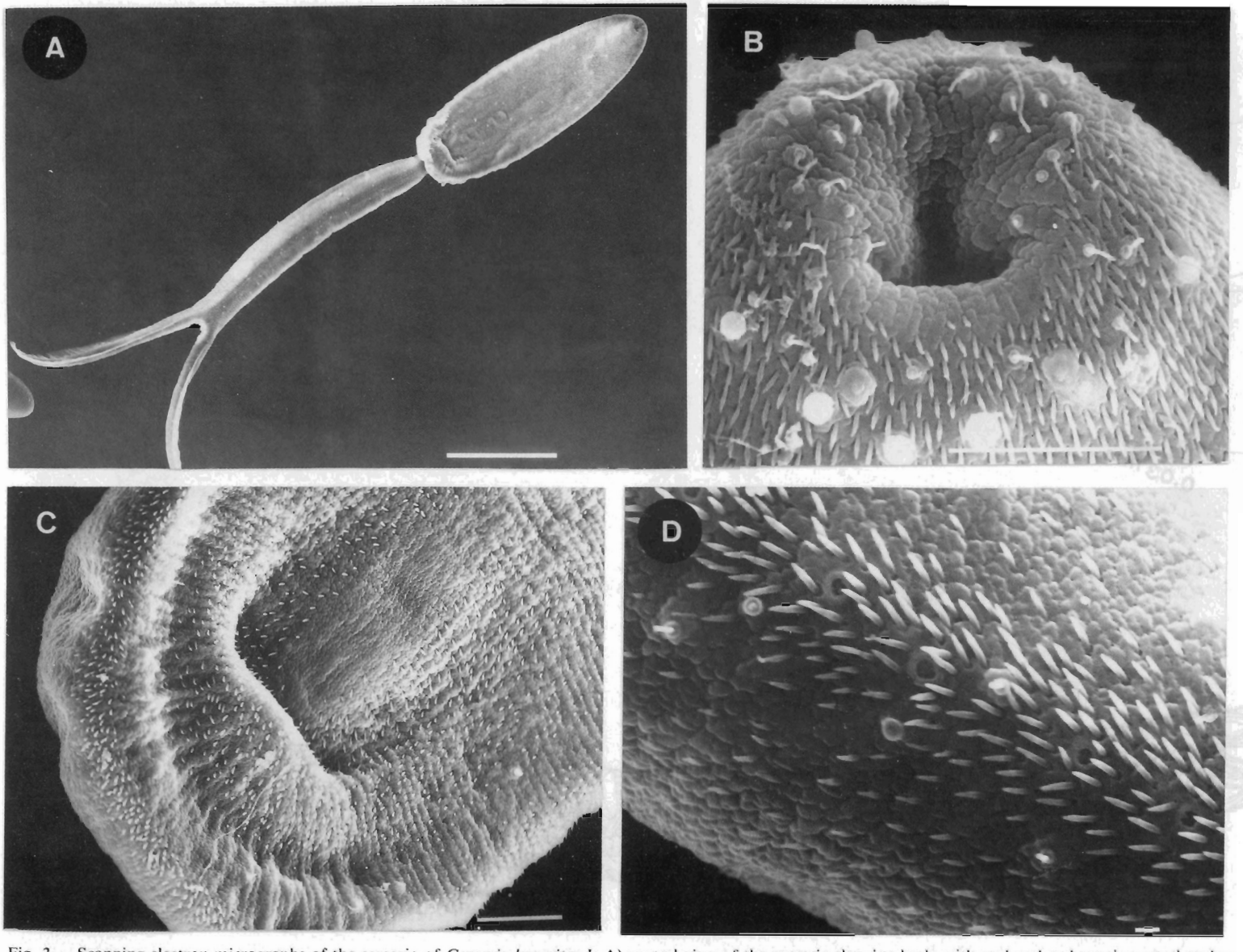

Fig. 3.— Scanning electron micrographs of the cercaria of *Cercaria kuwaitae* I: A) ventral view of the cercaria showing body with oral and embryonic ventral suckers, tail stem and finned tail furcae; B) ventral view of anterior region of the body showing oral sucker, oral opening, tegumental spines, ciliated and domed sensory papillae and penetration gland openings; C) ventral view of rim of the concave posterior region of the body showing arrangement of tegumentary spines; D) lateral aspect of the body showing arrangement of tegumental spines, openings of cystogenous cells and ciliated sensory papillae on ventro-lateral surface, and the aspinous dorso-lateral surface. Scale bars: A: 100 μm; B, C: 10 μm; D: 1 μm.

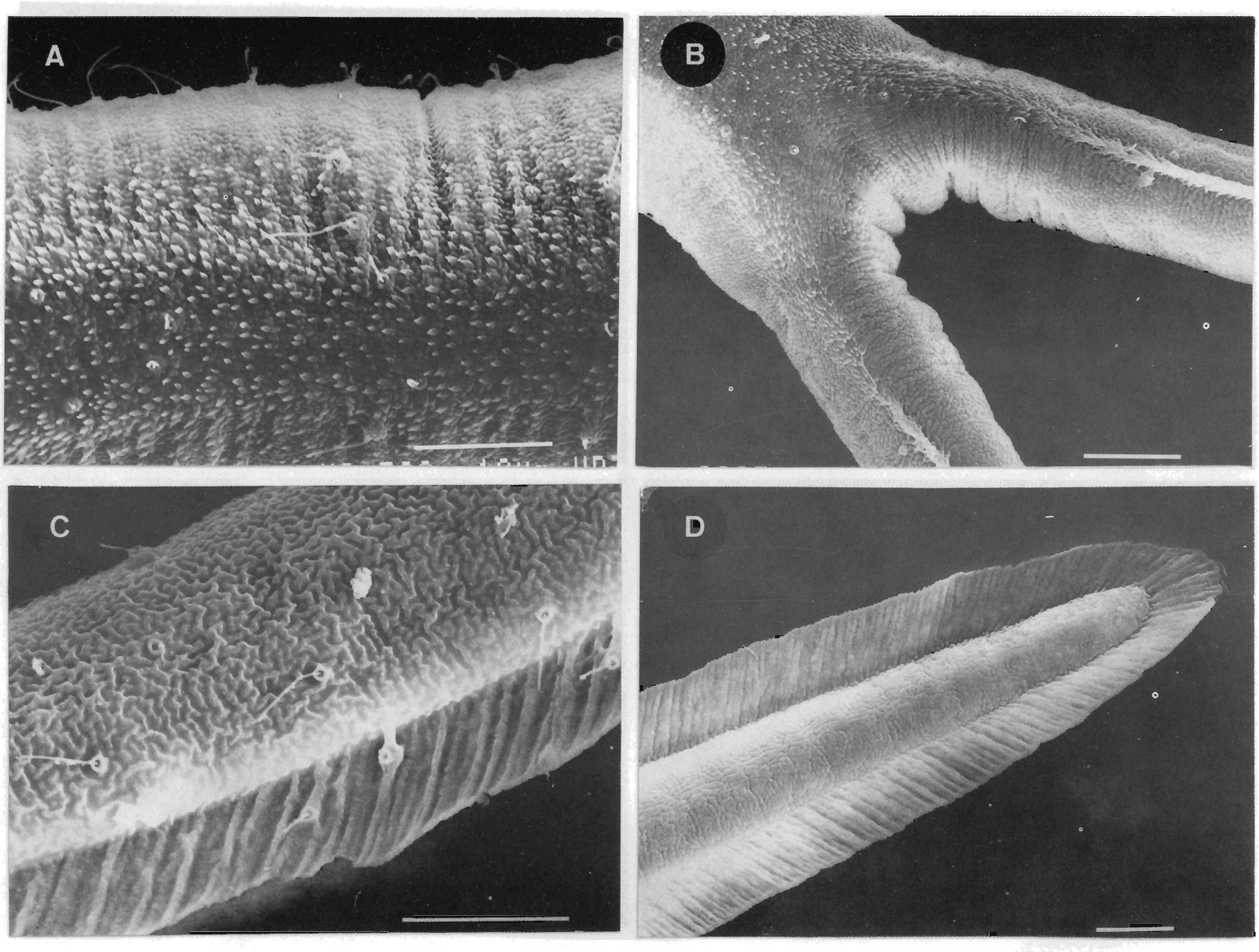

Fig. 4.— Scanning electron micrographs of the cercaria of *Cercaria kuwaitae* I: A) tail stem showing rows of long ciliated sensory papillae and short spines; B) distal end of the tail stem showing point of bifurcation, beginning of the dorsal fin and ciliated sensory papillae; C) internal surface of a furca showing ciliated sensory papillae on the furca and fin; D) external surface of a furca and fin devoid of sensory structures. Scale bars: A, B, C, D: 10 μm.

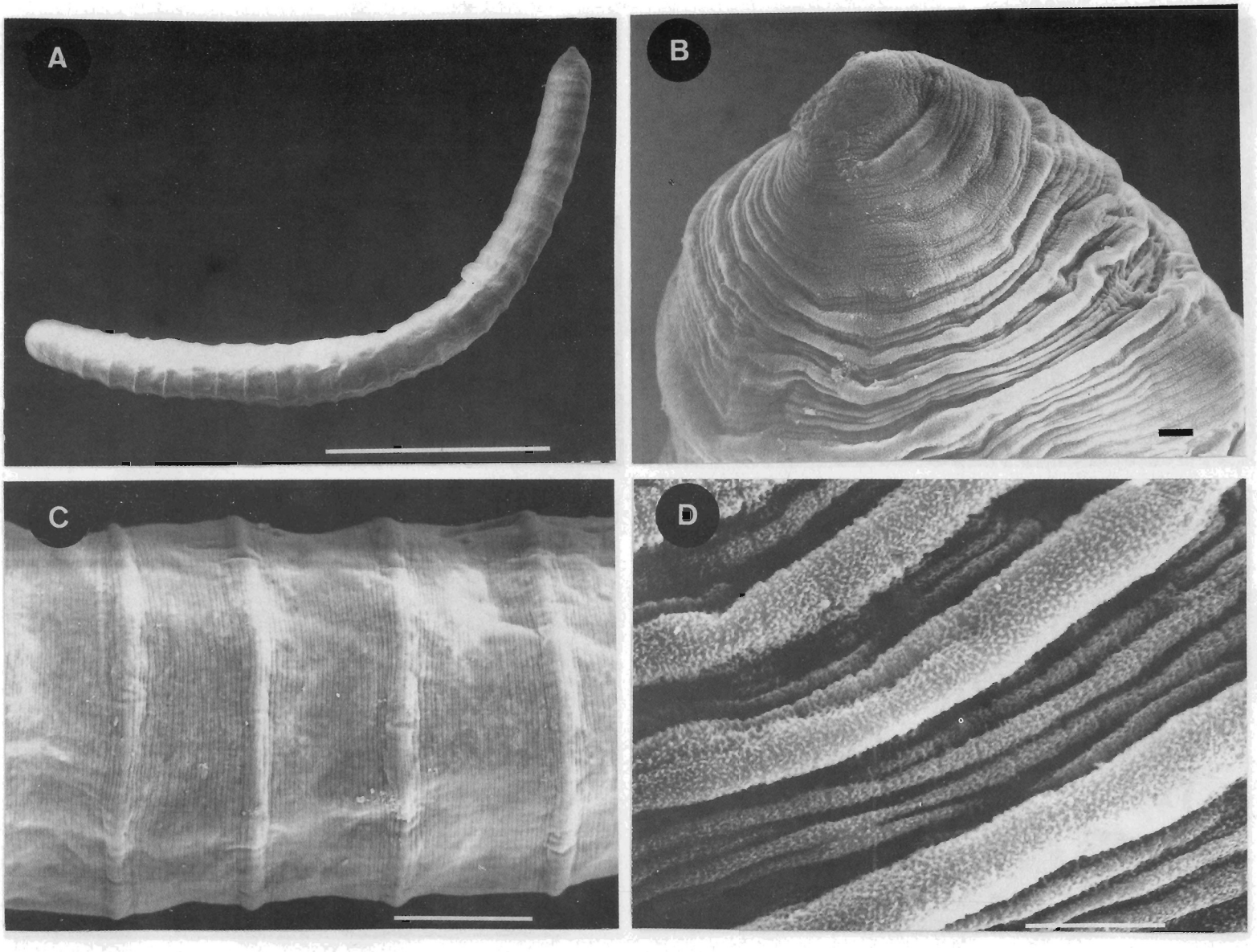

Fig. 5.— Scanning electron micrographs of the daughter sporocyst of *Cercaria kuwaitae* I: A) entire sporocyst showing pointed anterior and rounded posterior ends, and circumferential muscle bands; B) anterior region showing slit-like birth pore, ciliated sensory papillae and tegumental folds; C) surface of the sporocyst showing circular tegumental folds between muscle bands; D) dense arrays of microvilli covering the tegumental folds. Scale bars: A: 1 mm; B, D: 10 μm; C: 100 μm.

1988; JOYEUX & BAER, 1941; MYER, 1960; SEWELL, 1922; STANG & CABLE, 1966; VERNBERG, 1952; YAMAGUTI, 1975). *Cercaria kuwaitae* I differs from known cyathocotylid cercariae in the trifurcate branching of the anterior extensions of the lateral excretory tubules and in the presence of one to two islets in the caudal tubule. *Cercaria kuwaitae* I closely resembles *C. caribbea* LI as described by CABLE (1956) from *Cerithium algicola* collected from Parguera and Boqueron Bay, Puerto Rico, and *C. leighi* as described by HOLLIMAN (1961) from *Cerithidea scalariformis* collected from salt marshes of Florida. However, it differs from *C. leighi* mainly in extent of concretions in the excretory tubules, number of papillae on furcal fins, number and distribution of penetration glands and extent of cystogenous glands, and from *C. caribbea* LI in extent of flame cells in the tail stem and point of convergence of the medial excretory tubules relative to primordium of the ventral sucker. The swimming and phototactic behaviour described for *C. kuwaitae* I is similar to that described for other cyathocotylids.

The two types of papillae present on the tegument of *Cercaria kuwaitae* I have often been described at the ultrastructural level for juvenile and adult digeneans (KOIE, 1985), and are believed to have a sensory function. The uniciliate sensory papillae, common on the anterior region and tail of the cercaria, are possible tangoreceptors used in detecting a suitable second intermediate host. The two prominent hemispherical papillae present on the posterior rim of the oral sucker are possibly mechanoreceptors used in selection of penetration point on the skin of the second intermediate host. In the absence of a functional ventral sucker, attachment to the host skin is probably facilitated by the spined and ventrally concaved body. The simple pointed spines on the anterior and lateral aspects of the ventral surface of the cercaria are probably involved in the penetration and migration in the tissues of the host.

The surface area of the daughter sporocyst is amplified by extensive tegumental folds and microvilli, features that appear to be associated with absorption of nutrients from the surrounding molluscan tissue. Furthermore, the folded nature of the tegument of the daughter sporocyst probably provides flexibility and friction needed during movement through the molluscan host tissues. Presumed ciliated sensory papillae on the anterior region of the sporocyst probably act as chemoreceptors or mechanoreceptors facilitating movement within the molluscan host tissues.

Cercaria kuwaitae I is the first cyathocotylid cercaria to be described from a mollusc in the Arabian Gulf region. The definitive host is unknown, but cyathocotylid adults are known to occur mainly in the intestine of piscivorous birds (YAMAGUTI, 1975). It is possible that the adult of *C. kuwaitae* I develops in one of the sea birds that are abundant in the locality where the infected snails were collected.

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