

A NEW GENUS AND SPECIES OF TANTULOCARIDAN (CRUSTACEA: TANTULOCARIDA) PARASITIC ON A HARPACTICOID COPEPOD FROM THE SKAGERRAK

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The new genus and species, *Boreotantulus kunzi*, is described from *Cylindropsyllus laevis*, caught off the Isle of Bonden, Bohuslän, Skagerrak. It is placed in the Deoterthridae on the basis of its larval characters. It can be distinguished from other genera by the presence of a distinct praecoxal segment carrying the endite on larval thoracopods 2 to 5. This is the second tantulocaridan to be recorded in Scandinavian waters.

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INTRODUCTION

Tantulocaridans are small ectoparasitic crustaceans that utilise other crustaceans as hosts. Their life cycle includes an infective tantulus larva, a large free-swimming male, and a swollen sac-like female (BOXSHALL & LINCOLN 1987). None of these stages possesses any recognizable cephalic appendages so the taxonomy of tantulocaridans is based on body tagmosis, ornamentation, and the structure and armature of the swimming legs. These characters are best displayed in the tantulus larva and the adult male.

The only tantulocaridan recorded from Scandinavian waters is *Microdajus langi* GREVE. This occurs on several species of tanaid hosts in Raunefjorden, western Norway (GREVE 1965; BOXSHALL & LINCOLN 1987). A tantulocaridan, probably also *M. langi*, has been found on tanaids in Gullmarsfjorden (STIEG 1986). Tantulocaridans have not previously been reported from Scandinavian copepods although they have been recorded from copepods in the deep North Atlantic (BOXSHALL & LINCOLN 1983), in the Peru Trench (BECKER 1975), and off the coast of Tasmania (BOXSHALL 1988). During a review of the harpacticoid genus *Cylindropsyllus* BRADY (HUYS 1988) material of *Cylindropsyllus laevis* BRADY from the Skagerrak was examined. One male (Fig. 1A) was found to be infected with a tantulocaridan representing a new genus and species described below.

METHODS

Specimens were examined as temporary preparations in actophenol, under oil immersion on a Leitz Dialux 20 microscope with interference contrast. The isolated head

shields were successfully detached from the host and reattached to fragments of glass coverslip by the natural adhesion of the oral disc. The heads were then prepared for Scanning Electron Microscopy (SEM) whilst attached to the glass. They were dehydrated through graded ethanol, critical point dried, mounted on stubs, sputter coated with gold, and examined on a JEOL JSM-840 electron microscope.

TAXONOMY

Boreotantulus gen.n.

Diagnosis. Class Tantulocarida. Family Deoterthridae. Tantulus larva with first thoracic tergite largely concealed beneath posterior margin of dorsal cephalic shield; cephalic shield ornamentation consisting of fine longitudinal lamellae and pores; thoracopod 1 with single segmented protopod bearing medial endite; thoracopods 2 to 5 each with 2-segmented protopod, endite borne on discrete praecoxa; exopod of thoracopods 1 to 5 apparently 1-segmented with 3 (first leg) or 2 setae (legs 2–5) only; thoracopod 6 uniramous, without endite but bearing coupling spines on medial margin of protopod; abdomen of tantulus 2-segmented; caudal rami with 3 setae each.

Type species. *Boreotantulus kunzi* gen. et sp.n.

Etymology. The generic name is derived from the Latin *borealis* meaning North, and *tantulus* which forms part of the name of the class Tantulocarida.

DESCRIPTION

Boreotantulus kunzi gen. et sp.n.

Material examined. A single male *Cylindropsyllus laevis* collected by H. Kunz from a shell-gravel substrate in

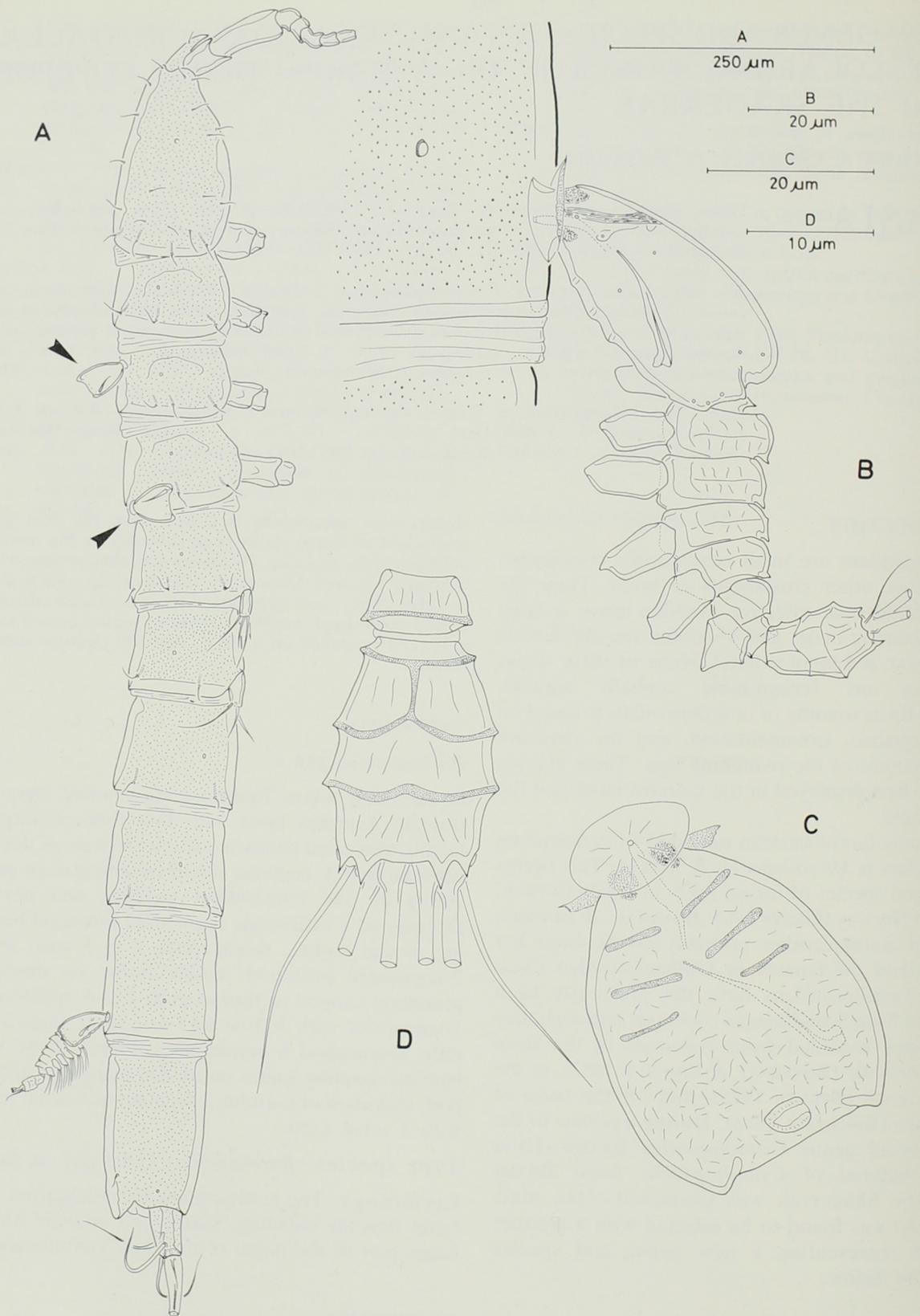


Fig. 1. *Boreotantulus kunzi* gen. et sp.n. A. Lateral view of male *Cylindropsyllus laevis* showing attached holotype tantulus of *B. kunzi* and paratype head shields (arrowed). B. Holotype tantulus attached to somite of host, lateral view. C. Cephalic shield, ventral view. D. Holotype tantulus abdomen, ventral view. Scales in μm .

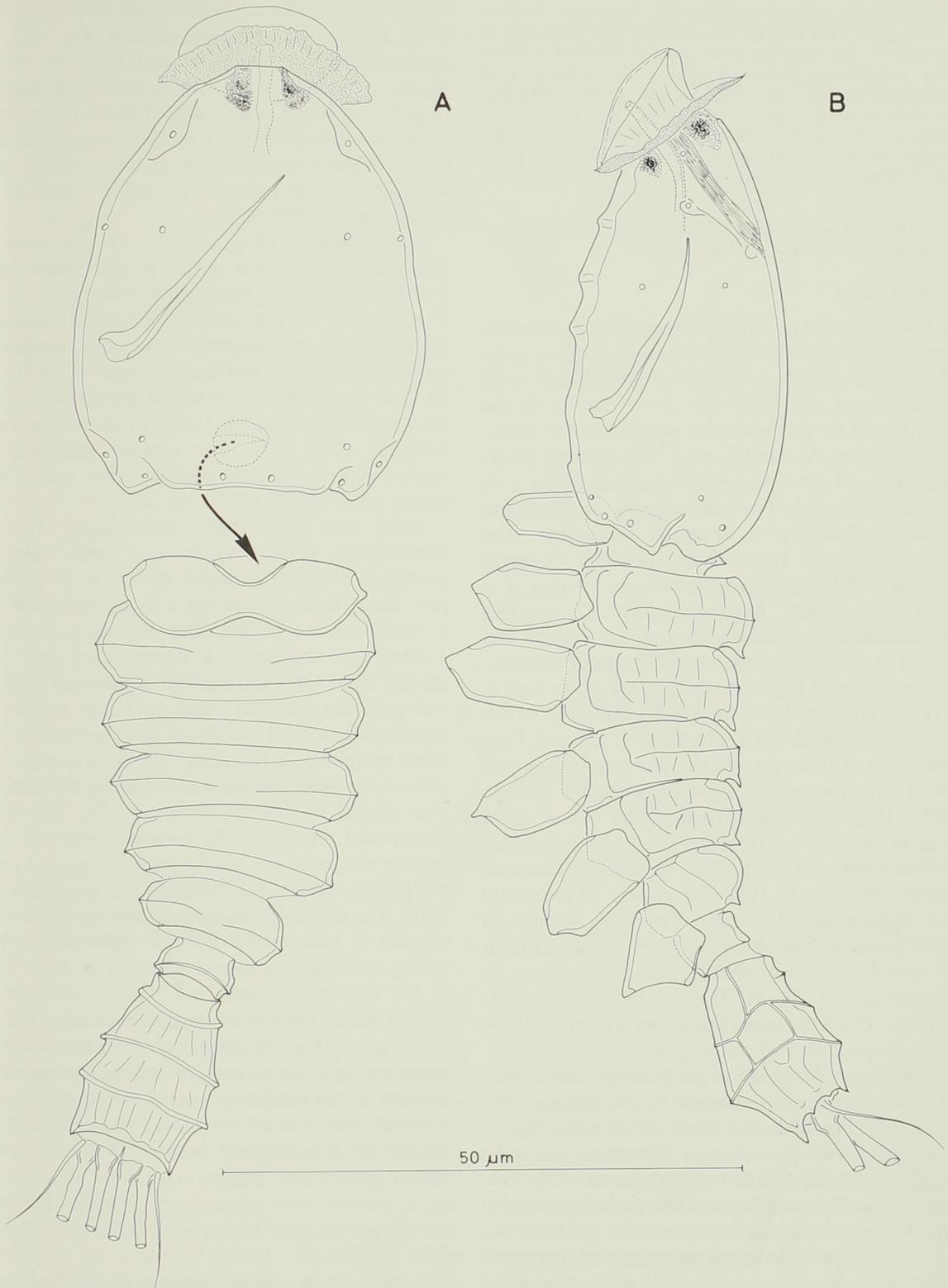


Fig. 2. *Boreotantulus kunzi* gen. et sp.n. A. Holotype tantulus, dorsal view with trunk drawn separately to reveal tergite of first thoracic somite. B. Same, lateral view showing thoracopodal protopods.

20 m off the Isle of Bonden, Bohuslän, Skagerrak, Sweden on 19 August 1974 carried one tantulus and two isolated head shields. The tantulus holotype was attached dorsally to the penultimate urosomal somite, the isolated head shields (paratypes) to the dorsal surface of the second and third free thoracic somites (Fig. 1A). The holotype is stored on 2 slides in the collections of the British Museum (Natural History), Registration No. 1988.197. The paratypes mounted on an SEM stub are in the first author's collection.

Etymology. The species is named after Dr Helmut Kunz who collected the host *Cylindropsyllus*.

Tantulus larva

The body (Fig. 2A) comprises a cephalon covered by an entire dorsal shield, 6 free thoracic somites, and a 2-segmented abdomen. The total body length is 98 μm , measured in dorsal view from the tip of the dorsal shield to the posterior margin of the abdomen, excluding the caudal setae. The cephalic shield (Fig. 2A) is 41 μm long and its greatest width is 34 μm . The downturned lateral margins of the shield are convex but slightly irregular in outline. The rostrum is absent. The oral disc is about 15 μm in diameter and is positioned anteriorly so that it is visible in dorsal view. There appears to be a ring of a fine membrane originating around the base of the disc and extending slightly beyond its outer margins. This membrane is held onto the surface of the host in life (Fig. 1B), thereby enclosing the oral disc. In the centre of the oral disc is a circular pore about 0.7 μm in diameter. The surface of the disc that comes into contact with the host is covered with fine stellate papillae (Fig. 4B). The surface of the dorsal shield has an ornamentation of extremely fine longitudinal lamellae which are just visible in scanning electron micrographs (Fig. 4A, D). The surface of the shield has a slightly ridged texture. There are 9 pairs of simple pores on the shield, 4 pairs in the anterior part and 5 pairs around the posterior margin as indicated on Fig. 2A, B. The ventral surface of the head (Fig. 1C) lacks pores but shows 3 pairs of ridges anteriorly.

Little can be discerned of the internal anatomy of the head. The stylet is clearly visible through the integument (Fig. 2A). It is about 24 μm long, slightly curved and is hollow at its base. The tip of the stylet is slightly rounded and does not taper to a very fine point. A short tubular organ leading from the central pore of the oral disc can be traced into the head but no further. The dorsal wall of the tubular organ is markedly thicker than the ventral wall. A striated organ, possibly a muscle, is visible in lateral view passing from the surface of the dorsal shield towards the base of the oral disc (Fig. 2B).

The 6 free thoracic somites each have a well developed tergite. The first tergite is usually con-

cealed beneath the cephalic shield. It is constricted in the midline and is unornamented (Fig. 2A). The junction between the head and the first thoracic somite is located on the ventral surface of the head (Figs 1C, 4C) and is very small (about 14 μm wide). Tergites 2 to 6 each bear a surface ornamentation of fine lamellae arranged longitudinally and transversely. Each free thoracic somite bears a pair of well developed swimming legs.

The abdomen (Fig. 1D) is 23 μm long and 2-segmented. The first somite is wider than long (5 \times 9 μm), the second longer than wide (18 \times 14 μm). The surface of the second abdominal somite is conspicuously ornamented with large lamellae arranged transversely and longitudinally (Figs 1D, 2A, B). The posterior margin of the abdomen is smooth dorsally but armed with 2 pairs of spinous processes ventrally (Fig. 1D). The caudal rami are each represented by 2 long medial setae and a short lateral seta, all of which are smooth.

There are no cephalic appendages. The first thoracopods (Fig. 3A) have a large undivided protopod bearing a medial endite at its proximal rim. Using light microscopy a single subapical spine is visible on the endite. The exopod is apparently 1-segmented and bears a strong outer seta and 2 shorter inner setae arising from a common base. The endopod has a broad basal part and a narrower, tapering distal part bearing 2 short processes on its inner margin near the apex. There is a single short seta on the outer margin midway along the endopod. The second to fifth thoracopods (Fig. 3B) have 2 protopodal segments; the proximal segment representing the praecoxa and bearing the medial endite, the distal segment representing the fused coxa and basis. The endite bears a single subapical spine. The exopod is reduced to a small segment bearing 2 strong setae. The endopod is similar in shape to that of the first thoracopods but bears 2 outer-margin setae and has a spatulate spine subapically. The sixth thoracopod (Fig. 3C) has a single protopodal segment and lacks the praecoxal endite. Two spines are present on the medial margin of the protopod. Only a single ramus is present and this is reduced to a vestige of the segment bearing 2 strong, curved setae.

DISCUSSION

The new genus exhibits several interesting characters, especially in the structure and armature of the thoracopods. The segmentation of the protopods of the second to fifth thoracopods is unique. No other tantulocaridans have a discrete praecoxal segment bearing the medial endite. In the tantulus stage of

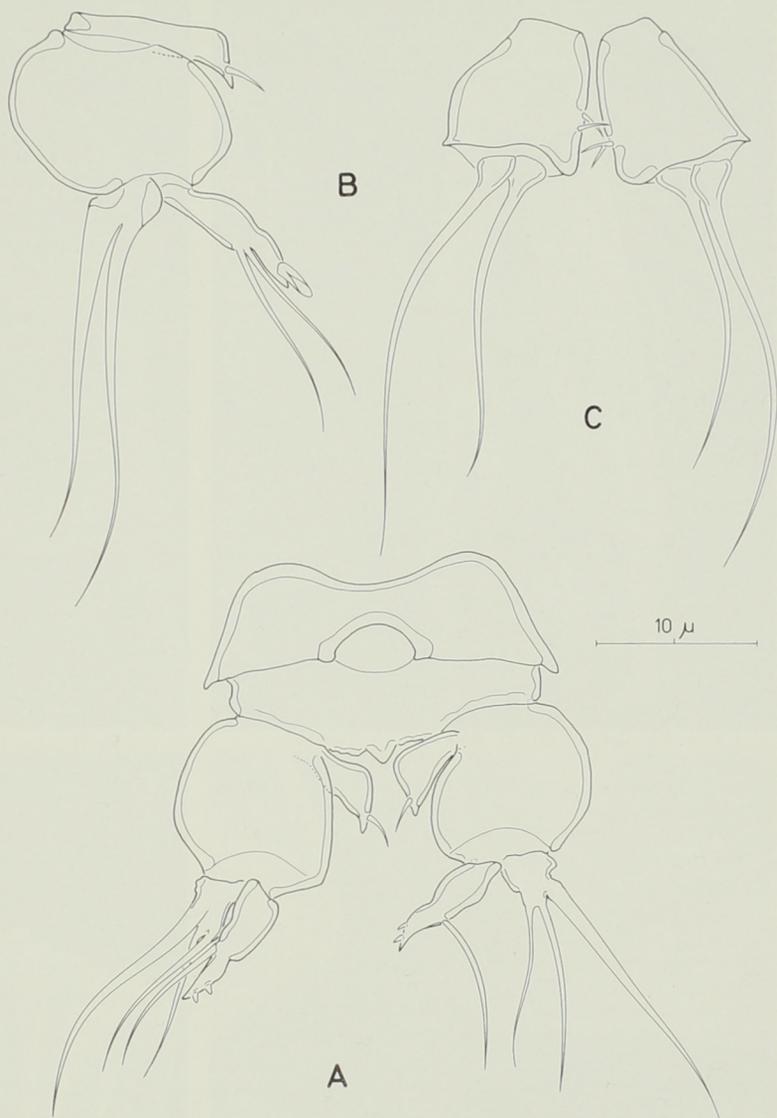


Fig. 3. *Boreotantulus kunzi* gen. et sp.n. Holotype tantulus. A. First thoracopod and first free tergite. B. Second thoracopod. C. Sixth thoracopod.

other known genera the praecoxa, coxa, and basis of all thoracopods are interpreted as fused to form a single protopodal segment (BOXSHALL & LINCOLN 1987). In the adult males of *Deoterthron* BRADFORD & HEWITT and *Microdajus* GREVE the fourth and fifth thoracopods have a protopod comprising a large proximal segment, presumably representing a syncoxa, and a small distal segment representing the basis (BOXSHALL & LINCOLN 1987). The brush setae located proximally on the medial margin of the male thoracopods may be praecoxal in origin and mark the plane of fusion between praecoxa and coxa. It is, therefore, probable that the ancestral condition of the tantulocaridan protopod was 3-segmented.

Itô (1985) compared the morphology of the

thoracopods of tantulus larvae with the postantennular appendages of maxillopodan nauplii, based on the incomplete information available in 1985. He suggested that the thoracopodal endite of the tantulus may represent a proximal protopodal segment which he then compared with the coxa of maxillopodan naupliar mandibles and antennae. *Boreotantulus* shows that the endite does represent a distinct segment as suggested by Itô (1985) but we believe this segment is the praecoxa. This further supports the opinion of BOXSHALL & LINCOLN (1987) that a comparison between naupliar appendages (antennae and mandibles) and thoracopods is invalid because of basic differences in organisation between these limbs; naupliar limbs have 2 protopodal segments

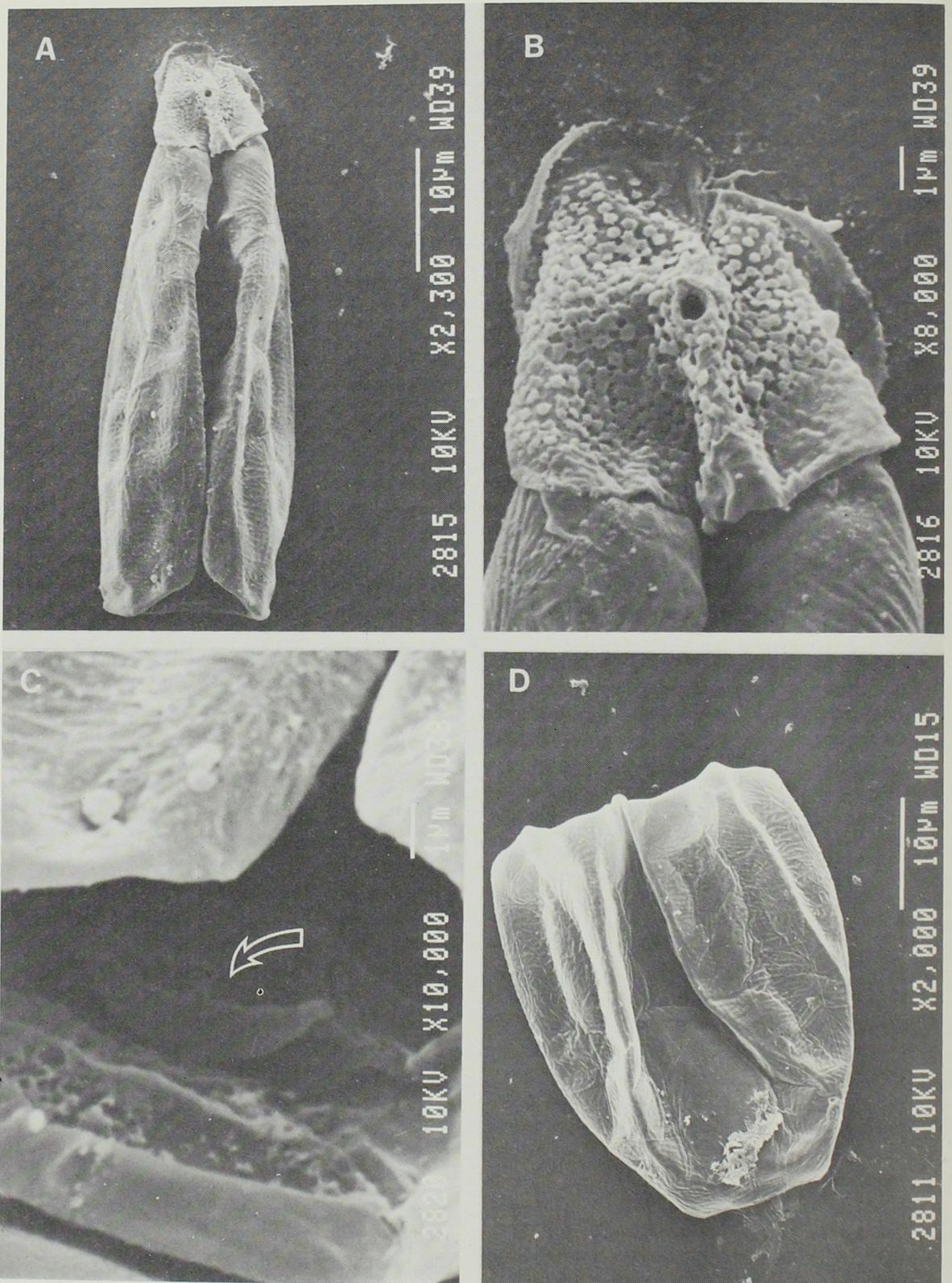


Fig. 4. SEM micrographs of *Boreotantulus kunzi* gen. et sp.n. A. Cephalic shield of first paratype with inrolled lateral margins, ventral view. B. Same, ventral surface of oral disc detached from host showing stellate papillae over surface. C. Same, showing crescentic scar where tantulus trunk was attached. D. Dorsal view of cephalic shield of second paratype showing fine longitudinal lamellae and ridged texture of shield surface.

whereas postmandibular cephalic limbs and thoracopods of maxillopodans primitively have 3, as shown by BOXSHALL (1985) for the maxillules, maxillae, and maxillipeds of copepods, and by the present account for tantulocaridans.

This is the first time that the concave surface of the oral disc has been observed. Previous attempts to remove the parasite resulted in tearing away of the underlying host integument (BOXSHALL & LINCOLN 1987). The concave surface is covered with stellate papillae which decrease in size away from the central pore. These papillae may be responsible for producing the adhesive secretion which causes the disc to stick to the integument of the host. The tubular organ inside the cephalon has a thicker wall dorsally than ventrally and it is possible that it may function as a guide for the tip of the cephalic stylet during extrusion of the stylet.

On the basis of its 2-segmented abdomen and the presence of well developed endites and rami on the thoracopods of the tantulus *Boreotantulus* is provisionally assigned to the Deoterthridae. Confirmation of this placement is dependent upon the characters of the adult male when it is found. It differs from known species of *Deoterthron* in the configuration of the cephalic shield which bears a prominent rostrum in the latter, as well as in the possession of a distinct praecoxa on the second to fifth thoracopods. It closely resembles *Austrotantulus* BOXSHALL which has recently been described from a harpacticoid copepod host off Tasmania (BOXSHALL 1988). It differs from *A. lincolni* BOXSHALL in the presence of only 2 setae (rather than the typical 4 setae) on the exopods of thoracopods 2 to 5 and in the complex ornamentation of large lamellae on the abdomen, compared to the smooth abdomen of *A. lincolni*. The familial position of *Austrotantulus* is problematical because, whilst the larval characters agree with the familial diagnosis of BOXSHALL & LINCOLN (1987) the position of the male trunk sac is typical for the Basipodellidae and Microdajidae. BOXSHALL (1988) placed *Austrotantulus* in the family Deoterthridae but noted that the familial arrangement of the Tantulocarida may require revision as new taxa continue to be found.

The new genus differs from members of the Basipodellidae in the possession of a 2-segmented abdomen. *Basipodella* BECKER, which is also found on copepod hosts, has a 6-segmented abdomen and *Onceroxenus* BOXSHALL & LINCOLN has a 3-segmented abdomen. It can be distinguished from members of the Microdajidae which are characterized by the absence of well developed endites and rami on the thoracopods of the tantulus larvae.

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