

A new genus and three new species of decapodiform cephalopods (Mollusca: Cephalopoda)

R. E. Young · M. Vecchione · C. F. E. Roper

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Abstract We describe here two new species of oegopsid squids. The first is an *Asperoteuthis* (Chiroteuthidae), and it is based on 18 specimens. This new species has sucker dentition and a funnel–mantle locking apparatus that are unique within the genus. The second new species is a *Promachoteuthis* (Promachoteuthidae), and is based on a unique specimen. This new species has tentacle ornamentation which is unique within the genus. We also describe a new genus and a new species of sepioid squid in the subfamily Heteroteuthinae (Sepiolidae) and it is based on four specimens. This new genus and species exhibits unique modifications of the arms in males.

Keywords *Amphorateuthis alveatus* · *Asperoteuthis mangoldae* · Cephalopoda · Oegopsida · *Promachoteuthis sulcus* · Species descriptions · Systematics

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Introduction

We describe three new species of cephalopods from three different families in two different orders that have little in common except they are from unusual and poorly known groups. The unique nature of these cephalopods has been known for over 30 years but they were not described because (1) with two species we waited for the collection of more or better material which never materialized and (2) with one species the type material was misplaced, virtually forgotten and only recently rediscovered. The 2006 CIAC symposium was the stimulus to finally publish these species which should have been published in the first CIAC symposium in 1985. These new species add to our understanding of three rather obscure groups: *Asperoteuthis*, the Promachoteuthidae, and the Heteroteuthinae. Additional information on all three new species described here can be found in the Cephalopoda pages of the Tree of Life on the WWW (<http://tolweb.org/tree?group=Cephalopoda&contgroup=Mollusca>).

Materials and methods

Specimens were collected during three different studies in three different oceans. *Asperoteuthis mangoldae* was collected during a University of

Hawaii program designed to sample the vertical distribution of midwater cephalopods off leeward Oahu, Hawaii during the 1970s (Young 1978). *Promachoteuthis sulcus* was taken during extensive midwater trawling from the R/V WALTHER HERWIG on cruises using large midwater trawls that fished much of the full length of the Atlantic Ocean during 1971–1973. *Amphorateuthis alveatus* was taken during bottom trawling from the R/V ANTON BRUUN during the International Indian Ocean Expedition of 1964. Specimens were fixed in formalin and preserved in 40–50% isopropanol. Most specimens reported here are deposited in the US National Museum of Natural History (USNM), Washington, DC. Terminology used is defined in the glossary of the cephalopod pages of the Tree of Life. Unless otherwise specified, measurements follow recommendations of Roper and Voss (1983).

Systematics

Family Chiroteuthidae Gray, 1849

Diagnosis—Arms with biserial suckers. Tentacular club usually with quadraserial suckers (suckers absent in *Grimalditeuthis*) but without proximal locking apparatus, keel or terminal pad. Buccal-crown connectives attach to ventral margins of arms IV. Neck elongate. Doratopsis paralarva (Young 1991).

Asperoteuthis Nesis, 1980

Diagnosis—Tentacular club with suckers on distal half (proximal half bare). Arms long, nearly subequal in length in large subadults. Funnel valve present. Funnel-locking apparatus morphology variable with either inverted Y-shaped groove defining weak tragus and strong antitragus or curved groove without antitragus. Olfactory organs well posterior to eyes. Photophores absent from viscera and arms IV. Large oval photophore patch on ventral surface of each eyeball. Single, large aboral photophore on tip of each tentacle. Luminescent pads on tentacle stalks.

Asperoteuthis mangoldae new species

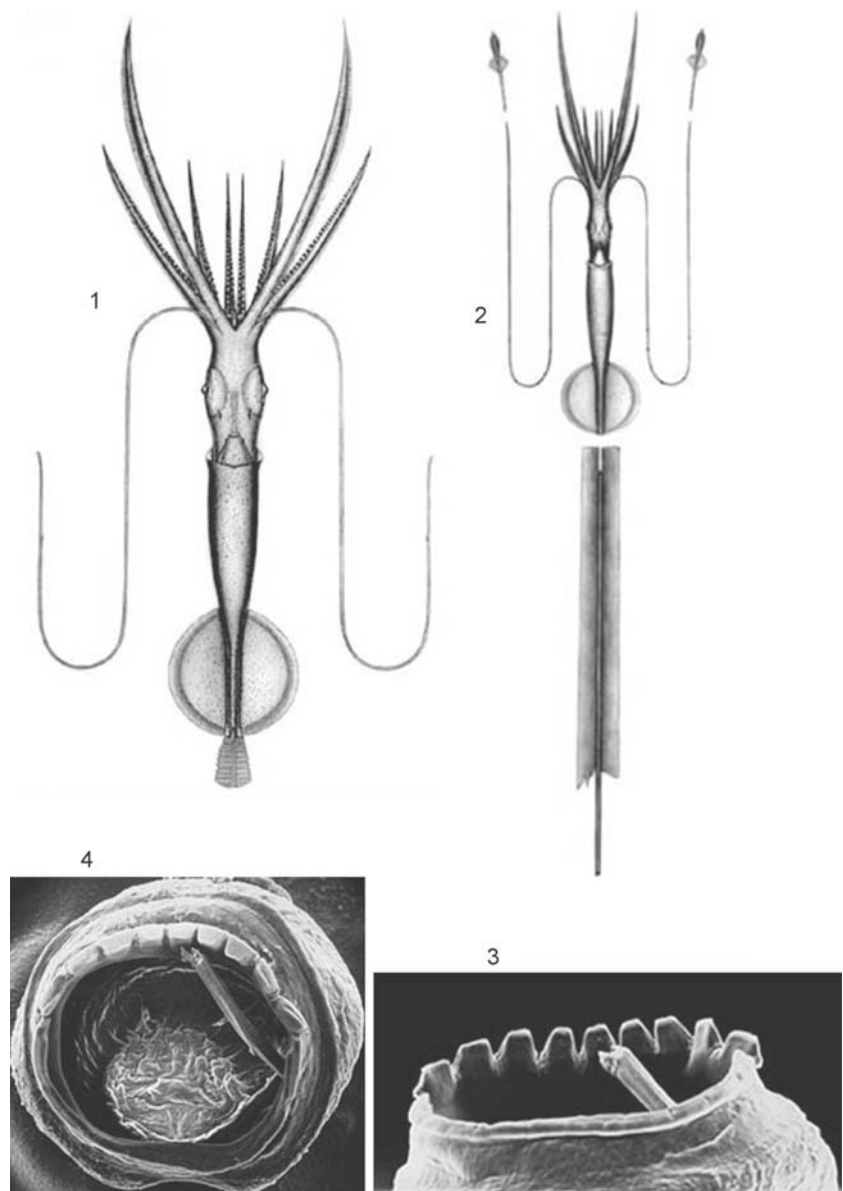
Material examined: Eighteen specimens taken in tows off leeward Oahu, Hawaii in the general region of 21°25'N, 158°20.5'W mostly during the years 1969–1978 on a variety of University of Hawaii vessels. The holotype (USNM 729749) is an immature male, 80 mm ML and the only specimen with an intact tentacular club. The paratype (SBMNH 369535) is a mature male.

Type locality: The holotype was captured in an opening–closing midwater trawl at 21°17'N, 158°22'W off leeward Oahu between 820 and 870 m during the day (14:11–16:16 h); 05 November 1972. The paratype (SBMNH 369535) was captured off leeward Oahu, Hawaii in the same region as the holotype in a midwater trawl at approximately 900 m in June 1996.

Diagnosis—An *Asperoteuthis* with funnel-locking apparatus with elongate, deep, curved groove. Integumental tubercles absent. Largest arm suckers with 9–10 separate, truncated teeth on distal half of inner ring. Club suckers with about 8 large, well-separated, truncated teeth on distal half of inner ring grading to about 17 small, truncated teeth on proximal half. Terminal club photophore small, associated with long, slender terminal papilla.

Description—The ventral aspect of the whole animal is depicted in Figs. 1 and 2. Largest arm suckers with about nine to ten truncated teeth on distal half of inner ring. Arm IV suckers much smaller than arm II suckers (Figs. 3, 4). Tentacular club suckers (Fig. 5) with about 8 large, truncated teeth on distal half of inner ring that grade to about 17 small, truncated teeth on proximal half (Figs. 6, 7). Proximal protective membranes on club very broad, nearly circular; each supported with 24–25 weak trabeculae (Figs. 8, 9). Distal protective membranes broad, narrowly oval, each supported by 13 broad trabeculae (Figs. 8, 9). Distal aboral club photophore small, round; terminal papilla large, long, slender (Fig. 9). Additional very small photophores embedded on aboral surface of club, about 13 on each side near bases of protective membranes. Single, large, oval photophore occurs on ventral surface of each eye (Fig. 10). Visceral photophores absent. Integumental tubercles

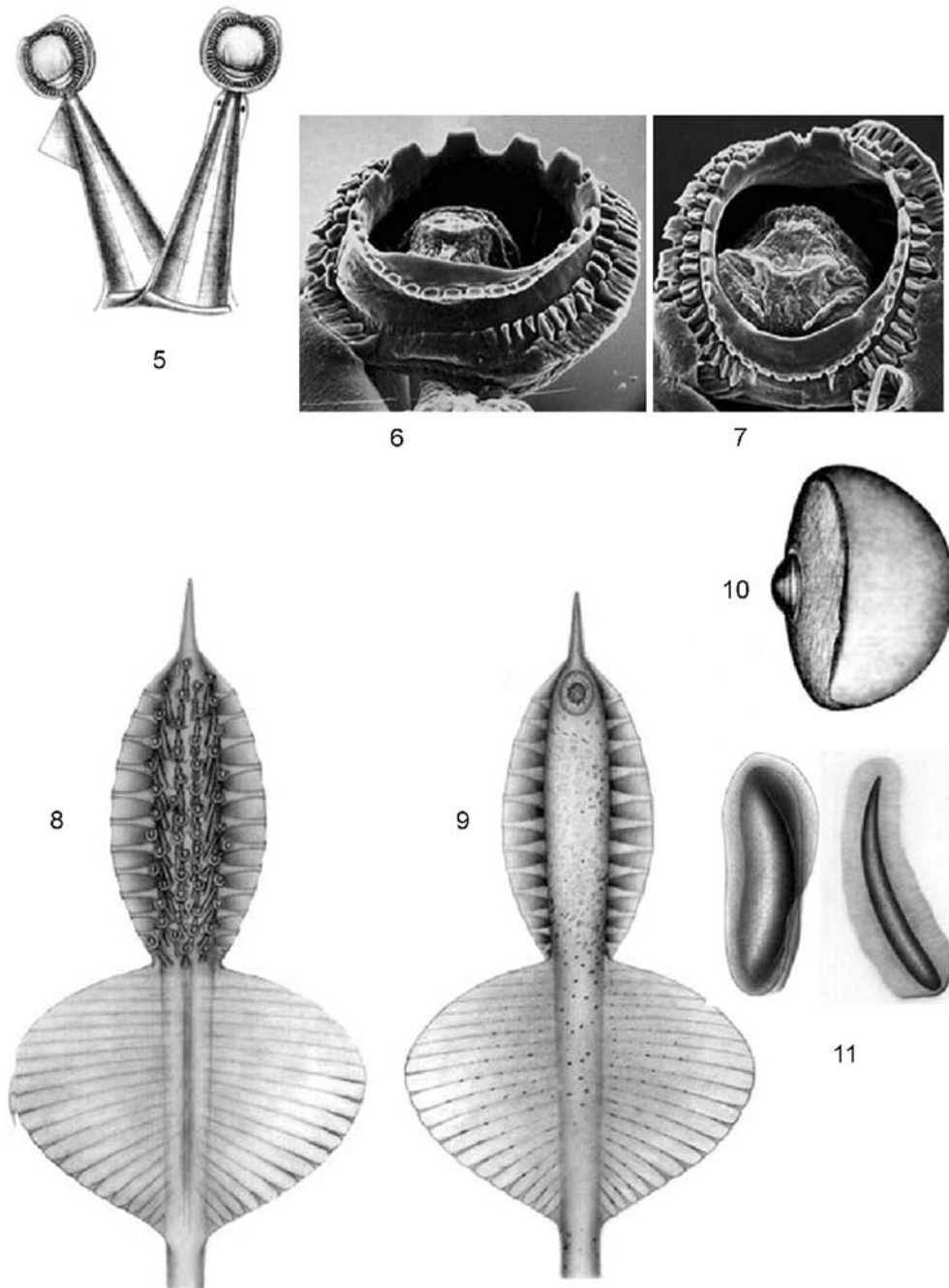
Figs. 1–4 (1) Ventral view of *Asperoteuthis mangoldae*, holotype, immature male, 80 mm ML, NMNH 729752. Drawing by A.D. Hart. (2) Ventral view of a small (80 mm ML) *Asperoteuthis mangoldae*, NMNH 729750, that was found in the same trawl as an elongate tail that presumably came from this specimen. Drawing is a composite of these two and the clubs from the holotype. Drawing by A.D. Hart. (3) *Asperoteuthis mangoldae*: Oral-proximal view of a large arm II sucker (sucker no. 10 from base), holotype, immature male, 80 mm ML. Scanning electron micrograph. (4) *Asperoteuthis mangoldae*: Oral view of the same arm II sucker, holotype, immature male, 80 mm ML. Scanning electron micrograph



absent. Funnel-locking apparatus with elongate, deep, curved groove on funnel component and matching, well-developed curved ridge on mantle component; antitragus absent (Fig. 11). Funnel valve present. Combined fins nearly circular (Fig. 1). Fin length 40% of ML; fin width approximately equals fin length. Mantle and arm tissue gelatinous. Arms IV longest, but greater size decreases with increased growth of squid. Pigmentation from scattered chromatophores on body and buccal membrane. Upper and lower beaks are illustrated in Figs. 12–14.

Standard measurements (in mm) are given in Table 1. Additional measurements and sucker counts for the holotype are: mantle width—13 mm, head length—30 mm, head width—9 mm, largest sucker diameter—0.6, 0.6, 0.7, 0.6 mm for arms I–IV, respectively; number of suckers on proximal half of arm III—25, arm IV—24.

Etymology—The species name honors the memory of Katharina Mangold and her long and productive career studying cephalopods, a portion of which was spent in Hawaii studying



Figs. 5–11 (5) *Asperoteuthis mangoldae*: Proximal view of two tentacular club suckers showing long stalks, holotype, immature male, 80 mm ML. Drawing by A.D. Hart. (6) *Asperoteuthis mangoldae*: Oral-proximal view of a tentacular club sucker, holotype, immature male, 80 mm ML. Scanning electron micrograph. (7) *Asperoteuthis mangoldae*: Oral view of the same tentacular club sucker, holotype, immature male, 80 mm ML. Scanning electron micrograph. (8) *Asperoteuthis mangoldae*: Oral view of the tentacular club, holotype, immature male, 80 mm ML.

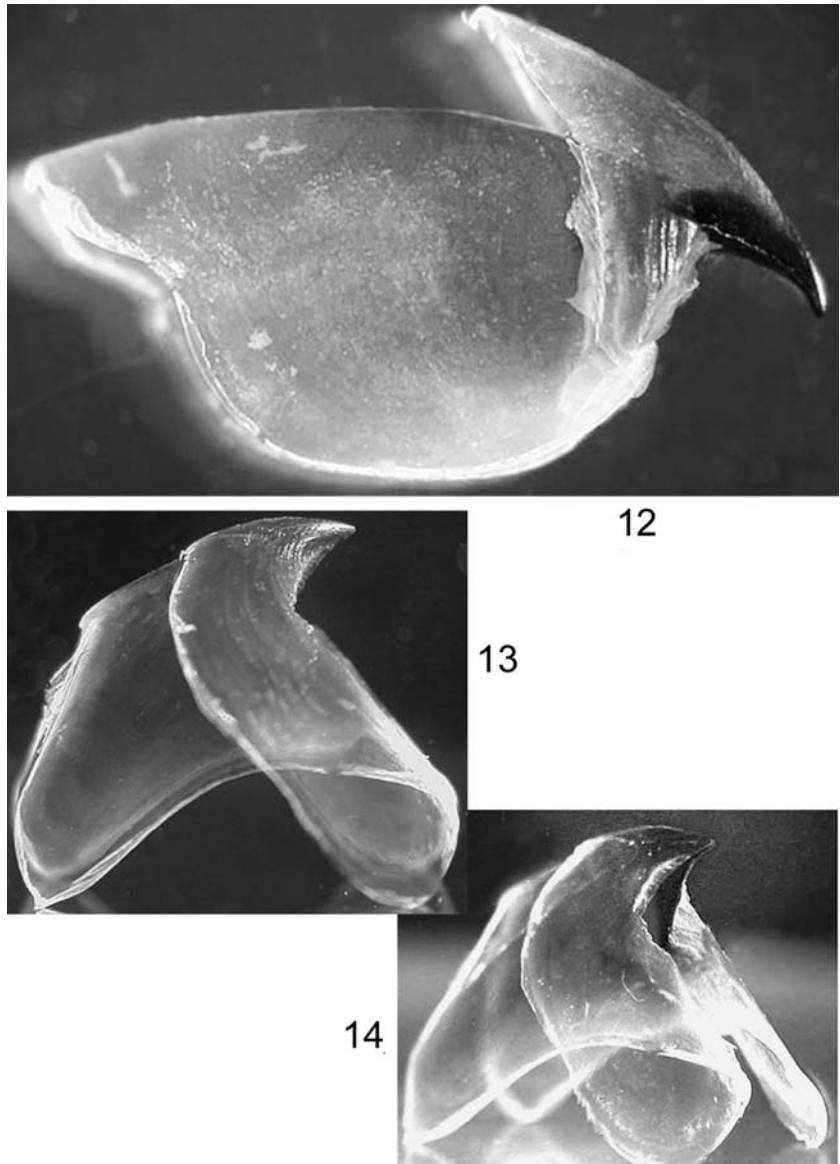
Drawing by A.D. Hart. (9) *Asperoteuthis mangoldae*: Aboral view of the tentacular club, holotype, immature male, 80 mm ML. Drawing by A.D. Hart. (10) *Asperoteuthis mangoldae*: Ventral view of an eye, paratype, mature male, 100 mm ML, showing the large ocular photophore, NMNH 729752. Drawing by A.D. Hart. (11) *Asperoteuthis mangoldae*: Funnel (left) and mantle (right) components of the funnel–mantle locking apparatus, paratype, mature male, 100 mm ML, NMNH 729752. Drawing by A.D. Hart

Figs. 12–14 (12)

Asperoteuthis mangoldae:
Upper beak, lateral view,
128 mm ML. (13)

Asperoteuthis mangoldae:
Lower beak, lateral view,
128 mm ML. (14)

Asperoteuthis mangoldae:
Lower beak, oblique
frontal view, 128 mm ML



squids taken at in the waters of the type locality of this species.

Comparisons with related species—Lu (1977) described a peculiar chiroteuthid squid, *Chiroteuthis acanthoderma*, from the tropical North Pacific. This species was quite different than all other members of the genus *Chiroteuthis*. Nesis (1980) recognized this difference and erected for this species a new genus, *Asperoteuthis*. Nesis, however, first placed *C. acanthoderma* as a junior synonym in the synonymy of the poorly known squid *Chiroteuthis famelica* Berry (1909)

which was known from the same region. He thereby designated *Asperoteuthis famelica* as the correct name for Lu's species. *C. famelica* is now known to be a valid member of the well-known genus *Mastigoteuthis* (e.g., Young 1978).

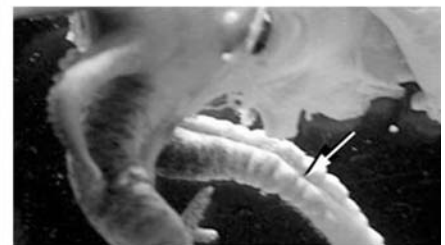
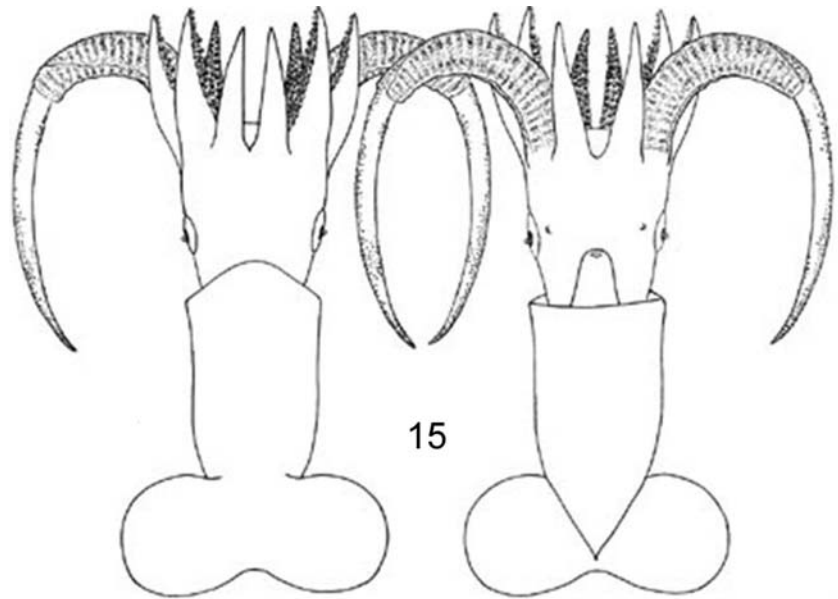
Under article 70.3.2 of the International Code of Zoological Nomenclature (fourth edition, 1999) we here fix *C. acanthoderma* (Lu 1977) as the type species for the genus *Asperoteuthis* in place of the type species *C. famelica* (Berry 1909) originally designated by Nesis.

Figs. 15–17 (15)

Promachoteuthis sulcus: Dorsal and ventral views of the holotype, 25 mm ML. Drawings by Keiko Hiratsuka Moore, National Marine Fisheries Service. (16)

Promachoteuthis sulcus: Oral view of brachial and buccal crowns, holotype, 25 mm ML. (17)

Promachoteuthis sulcus: Lateral view of head and aboral view of tentacle base, holotype, 25 mm ML. Arrow points to the deep groove in the aboral surface of the tentacle



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Asperoteuthis mangoldae differs from the type and only other named species of the genus, *Asperoteuthis acanthoderma*, in the following distinctive characters: (a) Minute tubercles are present in the skin of *A. acanthoderma*, but tubercles are lacking in *A. mangoldae*. (b) The consistency of the tissue of the arms and mantle of *A. acanthoderma*, while weak, is firmer than the nearly gelatinous consistency in *A. mangoldae*. (c) The funnel-locking apparatus of *A. acanthoderma* has an antitragus but the antitragus is absent in *A. mangoldae*. (d) Arm suckers of *A. acanthoderma* have three to four broadly rounded teeth, while *A. mangoldae* has eight to ten slender, truncated teeth. (e) Club suckers of *A.*

acanthoderma have 9 blunt teeth that coalesce at their bases along the distal half of the inner ring, while *A. mangoldae* has about 25 truncated teeth on the inner ring, that grade from large, separated teeth distally to small teeth proximally on the inner ring. (f) The terminal club photophore of *A. acanthoderma* is large, and oval, and it is associated with a short, blunt, terminal papilla, while the terminal club photophore of *A. mangoldae* is small, and nearly circular, and it is associated with a long, slender, terminal papilla. (g) The fin of *A. acanthoderma* is elongate (width 68–78% of length), while in the fin width of *A. mangoldae* slightly exceeds the fin length (width 114% of length).

Figs. 18–22 (18)

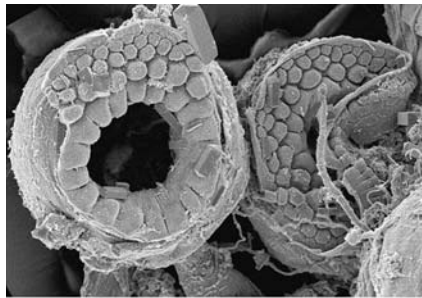
Promachoteuthis sulcus: Oral views of two club suckers, holotype, 25 mm ML. Scanning electron micrograph. (19)

Promachoteuthis sulcus: Oral view of large arm IV sucker (approximately sucker no. 10 from base), holotype, 25 mm ML. Scanning electron micrograph. (20)

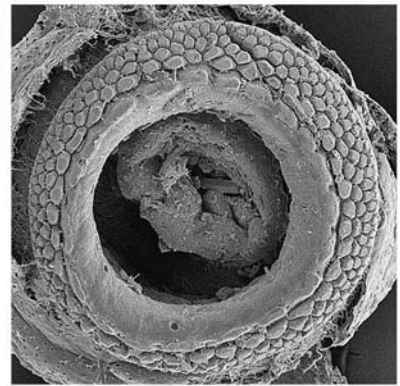
Promachoteuthis sulcus: Oral view of left arm I, holotype, 25 mm ML.

(21) *Promachoteuthis sulcus*: Oral view of distal portion of tentacular club, holotype, 25 mm ML.

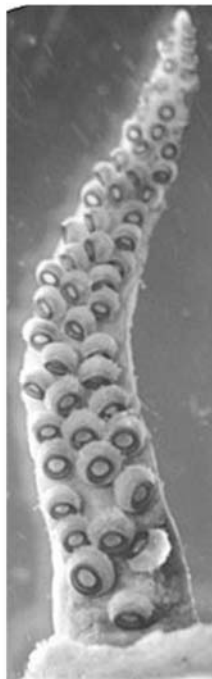
(22) *Promachoteuthis sulcus*: Oral view of proximal end of tentacular club, holotype, 25 mm ML, showing recessed club base and thick, folded surrounding tissue



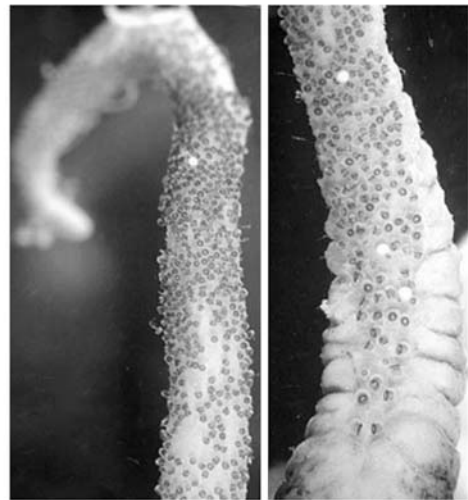
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Family Promachoteuthidae Naef, 1912

Diagnosis—Monogeneric; see diagnosis below.

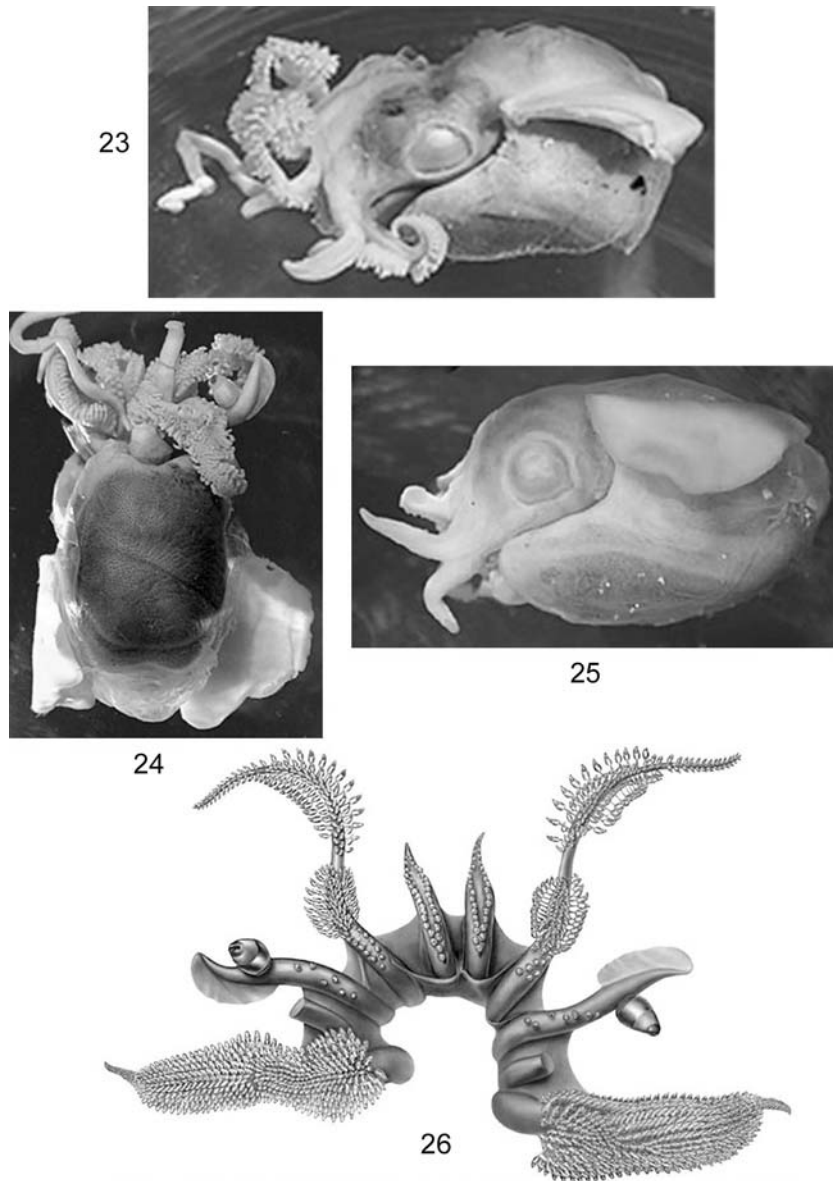
Promachoteuthis Hoyle, 1885

Diagnosis—Eyes small to very small with reduced opening to exterior. Funnel-locking apparatus with oval depression. Arms with two to three or more sucker series. Tentacular stalks generally thick; stalk width greater than width of arm III in most species. Tentacular club not expanded; club

without keel, locking apparatus or terminal pad; club with suckers in numerous irregular series. Anal flaps absent. Ink sac absent. Photophores absent. Gladius reduced and variable in shape among species.

Promachoteuthis sulcus new species

Material examined: The holotype (USNM 730702, 25 mm ML, immature female) was captured at 36°49'S, 12°17'W off Tristan da Cunha, south South Atlantic Ocean from by the R/V WALTHER HERWIG at 1,750–2,000 m depth



Figs. 23–26 (23) *Amphorateuthis alveatus*: Lateral view, paratype no. 2, mature (?) male, 15 mm ML. (24) *Amphorateuthis alveatus*: Ventral view, paratype no. 1, mature male, 14 mm ML, showing large shield, complex sucker arrangement on arm IV, and enlarged sucker on

arm III. (25) *Amphorateuthis alveatus*: Lateral view, paratype no. 3, immature female, 14 mm ML, showing short arms. (26) *Amphorateuthis alveatus*: Oral view of the arm crown, holotype, mature male, 14 mm ML. Tentacles removed for clarity. Drawing by Carolyn Gast

(open 1600 mesh Engel midwater trawl); 17 March 1971. This is the only specimen known to date.

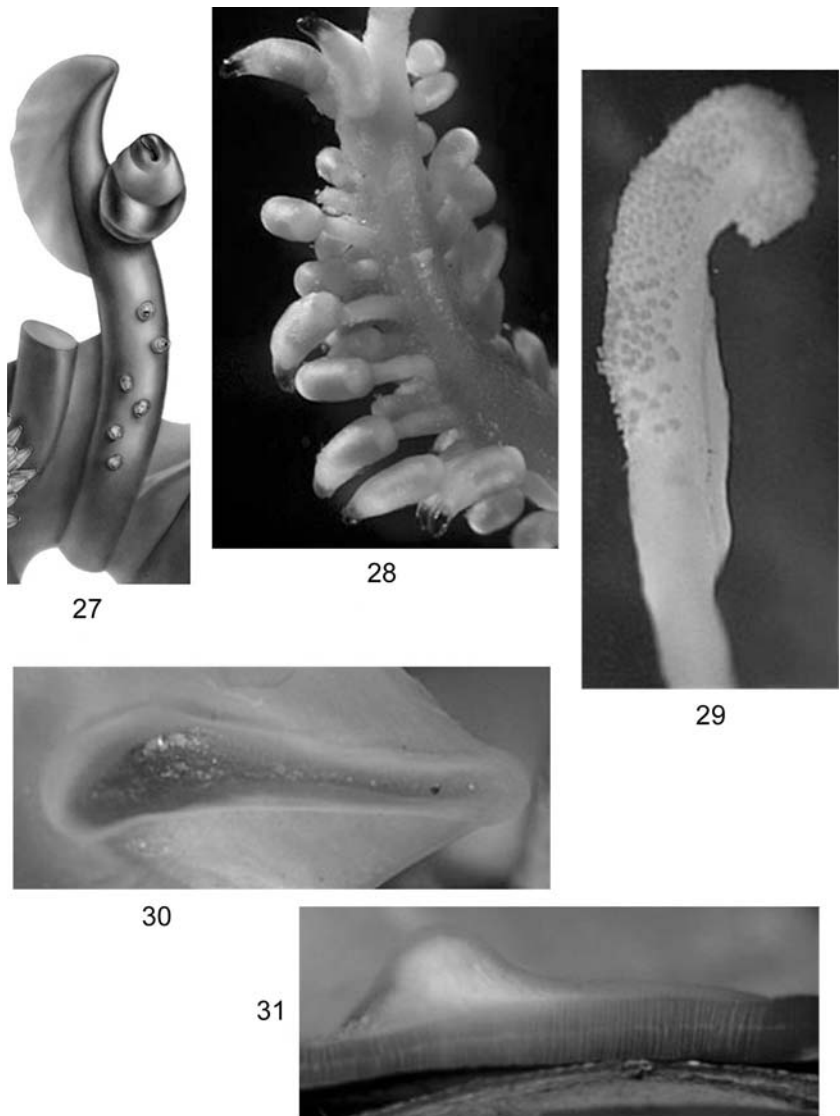
Diagnosis—Head and mantle fused in nuchal region. Mostly three series of suckers on arms. Arm suckers much larger than club suckers. Tentacle base wider than arm III base. Tentacle

with deep groove along aboral surface and club with recessed base. Tentacle stalk with dark pigmentation. Fins small.

Description—The dorsal and ventral aspects of the whole animal are depicted in Fig. 15. Tentacle base thick, about twice diameter of arm III (Fig. 16). Suckers on distal two-thirds to three-

Figs. 27–31 (27)

Amphorateuthis alveatus: Oral view of arm III, holotype, mature male, 14 mm ML, showing approximate biserial arrangement of suckers at arm base; large distal sucker and large aboral lobe. (28) *Amphorateuthis alveatus*: Aboral view near the tip of arm II, holotype, mature male, 14 mm ML, showing elongate suckers and their long stalks. (29) *Amphorateuthis alveatus*: Oral view of the right tentacular club, holotype, mature male, 14 mm ML, showing the larger proximal suckers. (30) *Amphorateuthis alveatus*: Frontal view of the funnel-locking apparatus, holotype, mature male, 14 mm ML, showing the slender posterior groove and deep anterior pit. (31) *Amphorateuthis alveatus*: Side view of the mantle-locking apparatus, holotype, mature male, 14 mm ML. Longitudinal section through the mantle adjacent to the mantle lock showing the large knob at the anterior end



quarter of tentacle (Figs. 15, 16). Tentacle-stalk with broad, deep groove along proximal third of aboral surface (Fig. 17). Club suckers minute (0.16 mm diameter), in numerous irregular rows; inner rings smooth (Figs. 18, 21). Sucker-bearing club recessed at tapered, proximal end; lateral and aboral tissue with thick cushion-like folds (Fig. 22). Club without keel, carpal-locking apparatus or terminal pad. Arms subequal in length, tips not attenuate (Fig. 16). Arms without keels; protective membranes low, without discernible trabeculae. Arm suckers in three, often irregular, series on all arms (Fig. 20). Arm suckers with

“smooth” inner rings (Fig. 19). Buccal connectives attach to the ventral margins of arms IV. Head fused to mantle in nuchal region. Eyes small. Eye opening contracted into raised, circular ridge. Olfactory organ small, papilla-like. Large oval dorsal funnel organ. Funnel-locking apparatus with deep, oval depression. Fins terminal, with anterior and posterior lobes present. Each fin approximately circular in outline. Anal flaps absent. Dorsal pad of funnel organ large, oval. Ink sac apparently absent (squid not dissected). Photophores absent. Tentacle stalks (about 25–35% of club length) heavily pigmented

Table 1 Standard measurements (mm) for selected specimens of *Asperoteuthis mangoldae*

Specimen	Holotype NMNH 729749	Specimen 1	Specimen 2	Specimen 3	Paratype SBMNH 369535
Sex	Immature male	Unknown	Unknown	Unknown	Mature male
Mantle length	80	128	120	82	100
Fin length	30	56	55	34	53
Fin width	37	72	66	39	67
Length					
Arm I	33	76	69	44	65
Arm II	41	86	73	46	75
Arm III	40	85	79	48	72
Arm IV	70	100	90+	95	86
Club length	15	Missing	Missing	Missing	Missing
Eye diameter	Damaged	Damaged	Damaged	Damaged	Ca. 17

with purple-brown color in integument, not chromatophores. Membranous covering of viscera, buccal membrane and oral surfaces of arms heavily pigmented with purple-brown color in integument, not chromatophores.

The clubs of *P. sulcus* are slightly abraded so the number of suckers in a transverse series could not be determined precisely. The largest number of those present was 12 suckers transversely across the club. The specimen is an immature female. The label in the specimen jar states that the ML is 40 mm; the squid currently measures 25 mm ML, the shrinkage, apparently, a result of the soft consistency of the body tissues.

Measurements (in mm) and sucker counts from the holotype are as follows: mantle length—25; fin length—9; fin width—18; head length—8; head width—9; eye diameter—2.5; tentacle length—36; tentacle width at base—3.8; arm III/IV width at base—1.9; arm lengths (average) I–IV, respectively—8.5, 8.5, 8, 9; sucker counts (average) arms I–IV, respectively—53, 50, 46, 51.5.

Etymology—The species name (*sulcus*, L. groove, furrow) refers to the characteristic, unique, aboral, furrow-like groove along the proximal one-third of the tentacular stalk.

Comparisons with related species—The Promachoteuthidae is monogeneric and now consists of three named species (*P. sulcus*, *P. megaptera* Hoyle, 1885 and *P. sloani* Vecchione and Young, 2005) and two unnamed but distinct species (*P. sp. B* and *P. sp. D*) (see the Tree of Life). *P. sulcus* is clearly different from all four other forms. The aboral groove on the tentacle of *P. sulcus* is unique among both named species of the

genus and *P. sp. B* (*P. sp. D* has lost its tentacles). Otherwise the most distinctive differences between *P. sulcus* and the other two named species are that the head and mantle are fused in the nuchal region in *P. sulcus* rather than being free, and that the fins are much smaller shorter (FL 35 vs 70% of the ML). All three species also show distinct differences in the structure and color of their tentacles. *P. sulcus* further differs from *P. sp. B* primarily by having three to four series of suckers on the arms, rather than two, and by having arm suckers much larger than club suckers, rather than their being equal in size. *P. sulcus* differs from *P. sp. D* primarily (1) in having tentacles that are thicker than the adjacent arms at their bases, rather than tentacles that are more slender (tentacles are missing in *P. sp. D* but tentacle stubs are present) and (2) by not maturing at an extremely small size.

Family Sepiolidae Leach, 1817

Diagnosis—Body short, rounded. Gladius present (often reduced) or absent. Fins broadly separated posteriorly. Hectocotylization not restricted to arms IV. Funnel-locking apparatus not fused.

Subfamily Heteroteuthinae Appellof, 1898

Diagnosis—Large interbrachial web extends to middle of arms I–III. Keel of tentacular club present only at base of club as narrow, elongate fold, paired with a reduced dorsal protective membrane to form a “tentacle organ” (except in *Sepiolina*) of unknown function. Visceral

photophores fused into large organ with single, circular lens. Ventral mantle mostly a “shield” and lateral mantle with silvery sides. Ventral mantle margin projects anteriorly.

Genus *Amphorateuthis* new genus

Diagnosis—In mature males suckers elongate, amphora-like, in numerous series on arms II and IV; single, greatly enlarged sucker present on distal half of each arm III. Funnel-locking apparatus with an elongate groove and a deep anterior pit.

Amphorateuthis alveatus new species

Material examined: Four specimens are available. The holotype (USNM 1084280), and paratype no. 1 (USNM 1084281), both mature males of 14 mm ML, and paratype no. 3 (USNM 1084283) all were taken from the Indian Ocean off the west coast of Tanzania at 06°51'S, 39°54'E by the R/V ANTON BRUUN at Sta. 9–422 at 100 m in a 40-ft trawl that apparently fished on the ocean floor; 19 November 1964. Paratype no. 2 (USNM 1084282) was taken nearby at 06°48'S, 39°51'E at R/V ANTON BRUUN Sta. 9–425 in a macro-benthos trawl (depth unrecorded); 20 November 1964.

Description—Lateral and ventral images of the whole animal are given in Figs. 23–25. Arms I short, with normal suckers in two series (Fig. 26). Arms II–IV in mature males highly modified (Fig. 26): Arms IV with ten or more irregular series of elongate, amphora-like suckers that grade to four to five series of normal suckers at arm tip (Fig. 26). Arms III each with six suckers biserially arranged (suckers well-spaced and each just lies slightly lateral to midline) in proximal half of arm and single, very large, elongate, amphora-like sucker on distal half of arm (Fig. 27). Arm III tips bare, devoid of suckers. Broad aboral flap (=keel?) present on distal third of arms III (Fig. 27). Arms II with two series of normal suckers proximally that grade to numerous series of elongate, amphora-like suckers distally to form a proximal brush-like set of densely crowded suckers (Fig. 26). Distal brush-like set of elongate suckers in numerous series separated from proximal set by short, bare sucker-free region of arm. Suckers of distal set

larger than suckers of proximal set. Elongate suckers continue to arm tip. Elongate, amphora-like suckers with nearly tubular, smooth, inner rings. Lateral, elongate, amphora-like suckers on arms II and IV with much longer stalks than on medial suckers (Fig. 28).

Female with short, relatively simple arms (Fig. 25). Arms I of single female available broken off, structure unknown. Arms II with biserial suckers and large, distal aboral lobe (=keel?). Arms III with biserial suckers proximally, distal half of arm suckerless and with large aboral lobe (=keel?). Arms IV with two series of suckers throughout and with well-developed lateral membrane joined to arm III to form outer side of extended tentacle pocket.

Tentacular clubs with numerous, irregular sucker series (Fig. 29). Basal suckers larger: about ten proximal transverse rows with suckers uniformly larger than more distal suckers. Tentacular organ present. Funnel-locking apparatus very elongate with deep anterior pit (Fig. 30). Mantle-locking apparatus with elongate ridge and large anterior knob (Fig. 31). Dorsal mantle broadly fused with head. Ventral mantle extends nearly to level of anterior edge of eyes. Ventral shield extends over 90% of ventral mantle. Fins large, extend to, or well beyond, posterior end of mantle. Posterior fin lobes, with posteromedial angle of about 90°.

Measurements (in mm) of the holotype and the three paratypes are given in Table 2.

Etymology—The prefix in the generic name (amphora, L.) refers to the flask- or amphora-shaped arm suckers in mature males and the species name (*alveatus*, L., hollowed out, pit) refers to the distinctive pit-like feature of the funnel-locking apparatus.

Comparisons with related species—The bizarre, unique sexual modifications of the arms in mature males and the peculiar morphology of the funnel-locking apparatus with a deep anterior pit, distinguishes *A. alveatus* from all other members of the subfamily. The elongate suckers and the large anterior extension of the ventral mantle are similar to that those of *Nectoteuthis pourtalesii*. The latter species, however, has elongate suckers in two series on all arms. In addition, the suckers of *N. pourtalesii* lack long stalks. Further, the

mantle and head in of *N. pourtalesii* are not fused and the fins do not extend to the posterior end of the mantle. *A. alveatus* also shares with *N. pourtalesii* the peculiar shape of the funnel-locking apparatus. Among the other genera in the Heteroteuthinae, *A. alveatus* is most similar to *Iridoteuthis iris* in the placement and shape of the fins, the broad dorsal fusion of the head and mantle, and the presence of large aboral lobes on some arms. The modifications of the arms in mature males and females, however, are entirely different between these species.

Discussion

Our present poor state of knowledge of the three cephalopod taxa reported here is due to several causes. Two of the species are lower mesopelagic to bathypelagic in habitat. The bathypelagic habitat is the largest animal habitat on this planet, and being well removed from the primary production of organic matter in surface waters, has low population densities. This information, of course is common knowledge; however, most biologists still have no appreciation of how vast the bathypelagic realm is. Even Herculean

attempts to sample this fauna with nets having mouths of 600 m² or more, as with the R/V WALTHER HERWIG, have been inadequate to sample of many of the species that live there. Only a single specimen of *P. sulcus* was captured during the HERWIG cruises. This sampling problem is compounded when studying species such as *A. mangoldae*. Not only is *A. mangoldae* a deep-living species [all the captures by Young (1978), came from about 800–1,000 m depth] but it is extremely delicate and can be damaged beyond recognition especially by the large pelagic nets needed to sample this habitat. Thus, only one of the specimens retrieved for this study had tentacles still attached. The third species represents an entirely different problem in sampling. The specimens of *A. alveatus* were taken in a bottom trawl at about 100 m depth. Other species in the same subfamily are usually taken between this depth and about 500 m or more and many are poorly known. These depths are, of course, too great for SCUBA diving and in many marine habitats within this depth range, rocky bottoms make standard trawling ineffective. We suspect that *A. alveatus* and some of its relatives prefer such inaccessible habitats. When these different sampling problems are solved, we predict that

Table 2 Standard measurements, in mm, for *Amphorateuthis alveatus*

Specimen	Holotype USNM 1084280	Paratype no. 1 USNM 1084281	Paratype no. 2 USNM 1084282	Paratype no. 3 USNM 1084283
Sex	Mature male	Mature male	Mature (?) male	Immature female
Dorsal mantle length ^a	14	14	15	14
Ventral mantle length	16	18	18	17
Lateral mantle length	10	11	13	11
Mantle width	12	11	14	11
Head width	11	13	16	13
Eye diameter	8	7	9	7
Fin length	11	13	14	13
Fin width	9	9	10	8
Length				
Arm I	6	6	7	Damaged
Arm II	19	18	18	4
Arm III	10	9	10	5
Arm IV	13	13	14	7
Club length	3.3	4.0	Damaged	Ca. 3.5

^a Dorsal mantle length measured to midpoint between eyes

many new species will be found in the three “obscure” groups reported here.

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References

- International Commission on Zoological Nomenclature (2001) International code of zoological nomenclature, 4th edn. The International Trust for Zoological Nomenclature 1999. Available from the internet URL <http://www.iczn.org/iczn/index.jsp>
- Lu CC (1977) A new species of squid *Chiroteuthis acanthoderma*, from the Southwest Pacific (Cephalopoda, Chiroteuthidae). *Steenstrupia* 4:179–188
- Nesis KN (1980) Taxonomic position of *Chiroteuthis famelica* Berry. *Bull Moscow Obshch Ispyt Prirody, Section Biology* 85:59–66 (in Russian)
- Roper CFE, Voss GL (1983) Guidelines for taxonomic descriptions of cephalopod species. *Mem Nat Mus Vic* 44:48–63
- Young RE (1978) Vertical distribution and photosensitive vesicles of pelagic cephalopods from Hawaiian waters. *Fish Bull* 76:583–615
- Young RE (1991) Chiroteuthid and related paralarvae from Hawaiian waters. *Bull Mar Sci* 49:162–185