The back-to-front plesiosaur *Cryptoclidus (Apractocleidus) aldingeri* from the Kimmeridgian of Milne Land, Greenland

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Smith, A.S. 2007–01–10. The back-to-front plesiosaur *Cryptoclidus (Apractocleidus) aldingeri* from the Kimmeridgian of Milne Land, Greenland. © 2007 by Bulletin of the Geological Society of Denmark, Vol. 55, pp. 1–7 (www.2dgf.dk/publikationer/bulletin)

In 1935, von Huene identified the partial skeleton of a fossil reptile from the Kimmeridgian of Milne Land, Greenland, as part of a plesiosaur. This specimen was used as the holotype of *Cryptoclidus (Apractoclidus) aldingeri*, but was interpreted erroneously. The specimen is here reinterpreted and described as the pectoral region and posterior portion of the neck. The specimen is not diagnostic past the level of family, and is regarded as Cryptoclididae indet – the species *aldingeri* therefore becomes a *nomen dubium.*

Key Words. Plesiosaur, Greenland, *Cryptoclidus*, von Huene, Jurassic.

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In 1935, a partial plesiosaur skeleton was discovered in Lower Kimmeridgian (Upper Jurassic) strata on the east coast of the island of Milne Land, Scoresby Sund, Greenland (Fig. 1). This specimen (MGUH 28378) (Fig. 2A, B) was described and figured (von Huene, 1935) as the holotype and only known specimen of a new species of *Apractocleidus* Smellie 1916 (at the time considered a subgenus of *Cryptoclidus* Seeley 1892). A novel specific name was proposed in honour of Dr. H. Aldinger, who discovered the specimen in 1933 during a Danish expedition on the east coast of Milne Land, and transported it to the Geologisk Museum in Copenhagen, Denmark.

In his 1935 publication, von Huene reconstructed the girdle elements of *Cryptoclidus (Apractocleidus) aldingeri.* These were taken to be a pelvic girdle exhibiting close similarities with *Apractocleidus teretipes* (Smellie 1916) – a wide pubis with a distinct anterolateral process and almost identical ischia. Although Persson (1963) considered this taxon to be valid, Bendix-Almgreen (1976, p. 567) later commented that: „one finds various features showing that von Huene apparently erred in his interpretation and redescription of this specimen is therefore needed".

Re-examination of MGUH 28378 indicates that von Huene (1935) did make some errors in his interpretation. The specimen was described as the pelvic region of a plesiosaur, including a partial pelvic girdle, posterior dorsal vertebrae, most of a tail, and a partial hind limb. However, the 'tail' is actually the posterior portion of the neck, the elements of the 'pelvic girdle' really belong to the pectoral girdle, and the partial 'femur' is interpreted a humerus. Von Huene interpreted the specimen backwards, a curious error from a historical point of view. E. D. Cope, infamously, placed the head of the plesiosaur *Elasmosaurus platyurus* on the end of the tail (Davidson 2002).

Consequently, this paper provides a redescription of the holotype specimen of *Cryptoclidus (Apractocleidus) aldingeri.* Its taxonomic affinity is re-evaluated and possible reasons are discussed for the high frequency of similar anatomical errors in plesiosaur palaeontology.

Abbreviations. MGUH, Geologisk Museum in Copenhagen, Denmark.

Systematic Palaeontology
Sauropterygia Owen, 1860
Plesiosauria de Blainville, 1835
Plesiosauroidea Gray, 1825
Cryptoclididae Williston, 1925

Gen. and sp. indet.

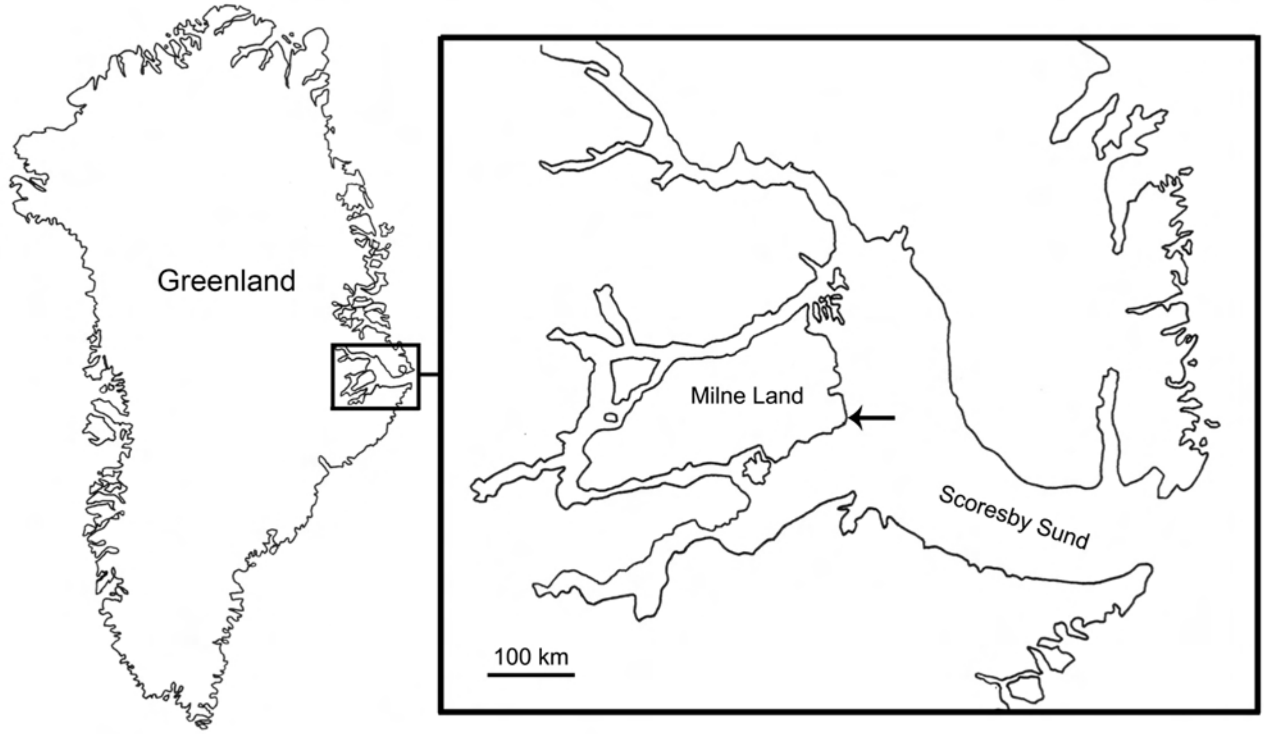


Fig. 1. Map of Greenland to show the location of MGUH 28378 (arrow) on the east coast of Milne Land, Scoresby Sund.

Description

General

MGUH 28378 is preserved on two slabs (Fig. 2A, B). The main slab (90 cm by 48.5 cm) contains most of the bones, while a second small slab contains additional limb elements. The main slab has been mounted in plaster, and is surrounded by a plaster border. The skeleton comprises a partial pectoral girdle, anterior dorsal vertebrae, posterior cervical vertebrae and cervical ribs, dorsal ribs and gastralia, 'pectoral' vertebrae, and a partial forelimb. It is apparent that this fossil was damaged some time after von Huene (1935) described it. A number of loose fragments from the region of the dorsal vertebrae, including parts of the pectoral girdle, can be restored to their natural relationship based on the published figures.

The exact position of the two slabs relative to each other is unclear and open to interpretation. The distance between the slabs can be estimated by measuring the depth of the humerus – it tapers distally at a constant rate from which a gap of approximately 2 cm can be calculated. The relative orientation or the slabs was inferred from aligning the curvature of the humerus border on respective slabs but such a technique is of course open to minor error.

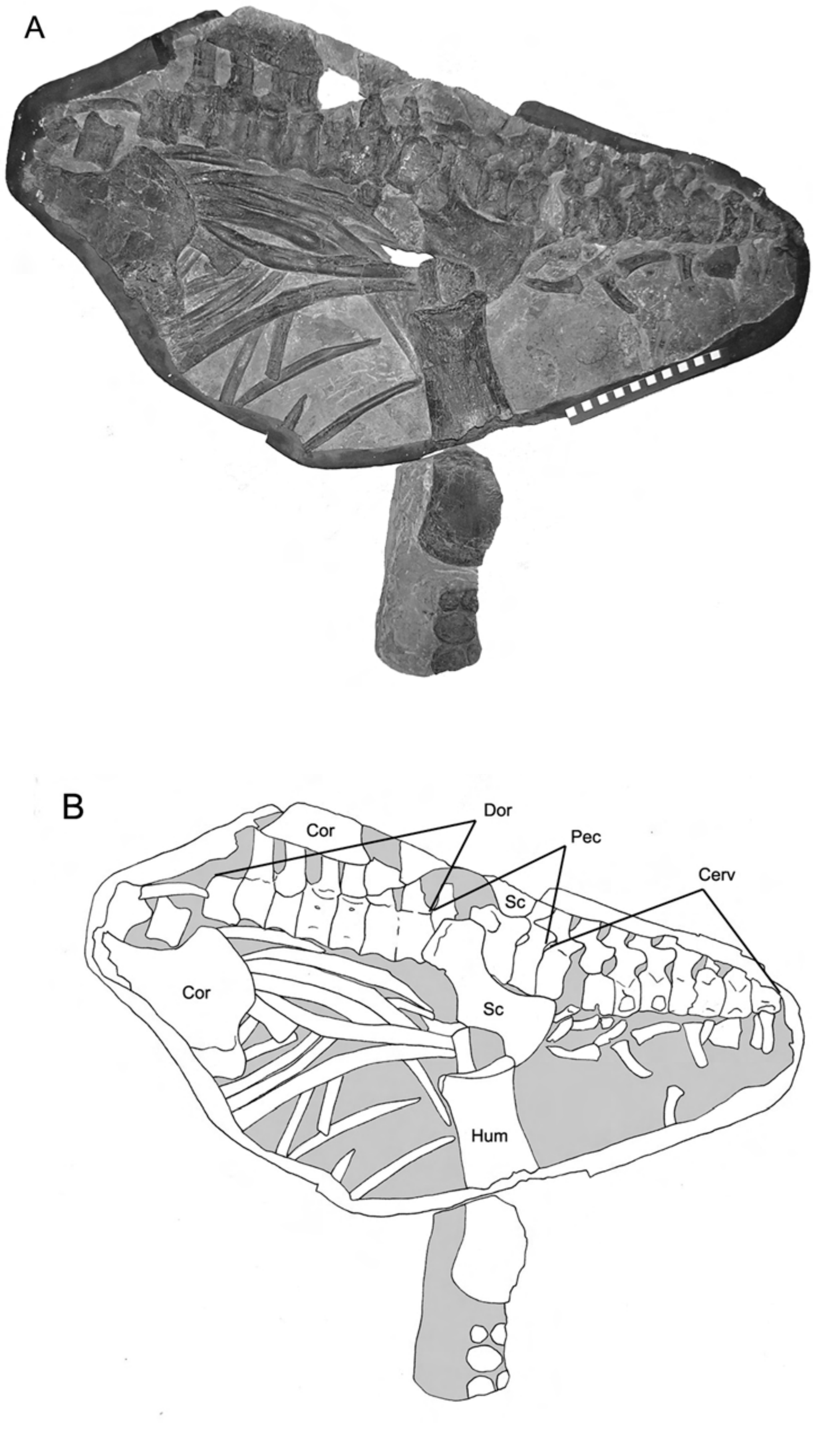
Cervical vertebrae and cervical ribs

The cervical vertebrae are exposed in right lateral view and preserved in natural articulation so that the postzygapohyses are obscured by prezygapophyses. Cervical centrum height is roughly equivalent to length. Owing to the nature of the vertebrae in the matrix no accurate measure of centrum width could be obtained, but the VLI plot (vertebral length index) based on centrum height does not deviate far from the condition seen in the same region of *Cryptoclidus* (Brown 1981). The cervical neural spines are all chopped off by the edge of the slab and so their heights cannot be determined.

The cervical ribs are single headed with circular facets and are predominantly detached from their respective facets on the centra – they are scattered in the matrix adjacent to the vertebrae. A few loose cervical ribs can be removed separately from discrete depressions in the matrix into which they neatly fit. In particular, one complete rib (Fig. 3) is situated in articulation with the left rib facet of the 2nd cervical vertebra. It is very slightly recurved posteriorly with a rounded antero-distal tip and sharp postero-distal tip (Fig. 3A). It possesses a distinct kink in the vertical plane, so that it appears as a shallow ventrally pointing 'V' in anterior/posterior aspect (Fig. 3B).

The neural arches and prezygapophysis are tall and the prezygapophyses have rounded, almost cir-

Fig. 2. A. Photograph of the complete restored specimen MGUH 28378. Note the plaster border. B. Outline drawing and interpretation of A. Abbreviations, Cerv, cervical vertebrae; Cor, coracoid; Dor, dorsal vertebrae, Hum, humerus; Sc, scapula. Grey: matrix; white: bone. Scale bar = 20 cm.



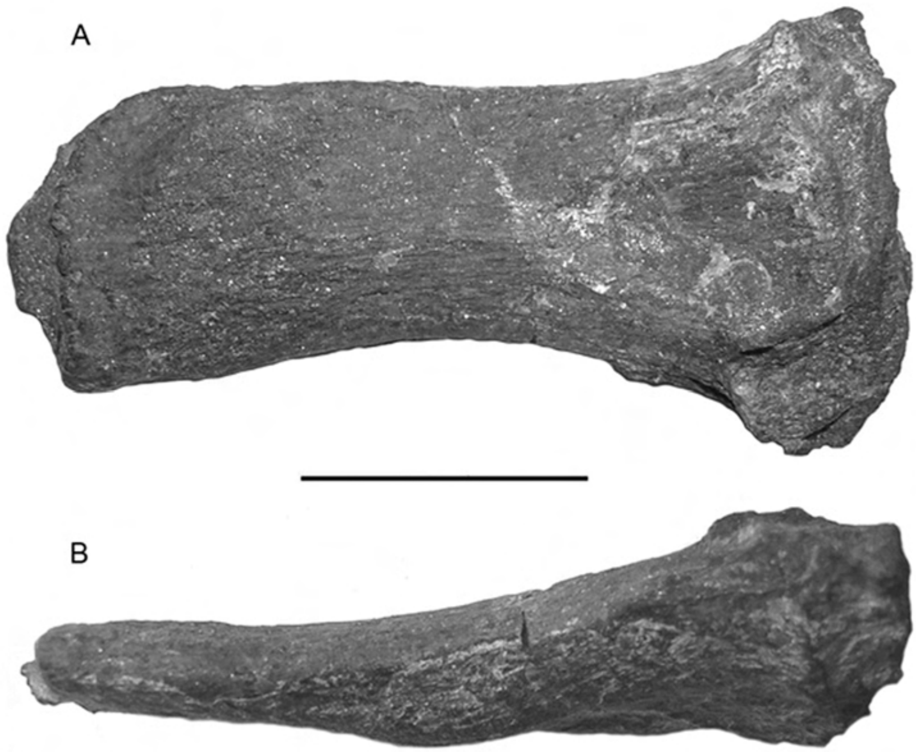


Fig. 3. Representative left posterior cervical rib of MGUH 28378 in A, dorsal view, and B, anterior view, to show slight 'V' shaped kink and tall articular facet. Scale bar = 20 mm.

cular margin. Each neural spine is situated posterior to the centrum so that the posterior border of the centrum is level with the middle of the neural spine long-axis in lateral view. The cervical neural spines appear to be oriented vertically and not angled backwards.

Dorsal vertebrae

Despite the misinterpreted direction, von Huene's interpretation of the dorsal vertebrae is otherwise correct. MGUH 28378 has suffered some damage in this region, affording more information. The neural spine and both transverse processes can be identified. All three have been crushed so that they run parallel to each other, the process tips are obscured by a fragment of coracoid(?) so their length cannot be measured. A very slight longitudinal 'U' shaped ridge occurs just dorsal of the nutritive foramina, situated high on the lateral surface of the centrum - the centrum surface is otherwise smooth and unornamented.

Girdle elements

Four girdle elements are preserved in various states of completeness. Only one is complete enough to be confidently identified, the other three are fragments. These girdle bones were interpreted and reconstructed by von Huene (1935, fig. 3, p. 6), as a pelvic girdle. This erroneous interpretation was presumably based on the misconception that this was the pelvic region, these bones are here reidentified as elements of the pectoral girdle (Fig. 4).

Scapulae

Von Huene identified the most complete girdle element in MGUH 28378 as an ischium. This bone is actually the left scapula exposed in ventral aspect - there is a distinctive ridge running along its lateral margin and there are two distinct facets on the posterior process, one for articulation with the associated coracoid, the other forms the glenoid facet for the humerus. This morphology contrasts with the condition seen in plesiosaur ischia. There is no ridge on plesiosaur ischia, and the area of articular facets is more extensive, to accommodate three (rather than two) elements: the pubis, femur (glenoid), and ilium. The dorsal ramus of the scapula of MGUH 28378 cannot be observed and may be either diminutive,

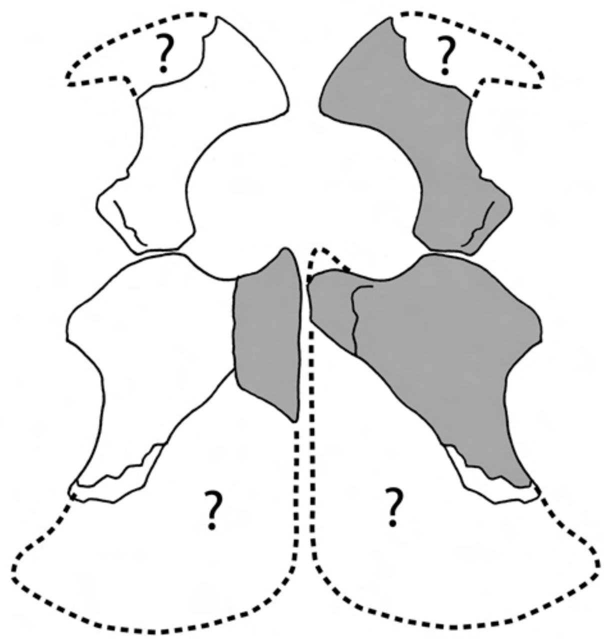


Fig. 4. Outline drawing of the pectoral girdle elements of MGUH 28378 in a tentative reconstruction (ventral view). The preserved elements are shaded grey; some unpreserved parts of the girdle were reconstructed by mirroring single elements (white, continuous outline); dotted lines indicate suspected outline of unknown portions, based on Andrews (1910).

or penetrating the matrix. Incidentally, this mistake was also made for the plesiosaur *Leurospondylus ultimus* Brown 1913, from the Upper Cretaceous of Alberta (Brown 1913). Elements identified as ischia were actually scapulae – they were subsequently figured correctly by Welles (1962, fig. 21).

Situated dorsal to the vertebral column is the remains of a girdle element identified by von Huene as a partial ilium. This now loose bone is actually the partial counterpart (right) scapula, as can be determined from the identical length and geometry of the preserved parts of both left and right bones.

Coracoids

Two additional partial girdle elements are preserved in MGUH 28378. Their size and position is consistent with their identification as coracoids. Considering the partially articulated nature of the specimen, it is unlikely that pelvic elements would have moved to, and coracoids moved from, this position without severely disrupting the rest of the skeleton. However, these bone fragments are too incomplete to allow confident assignment or to confidently interpret their orientation – the most likely arrangement and orientation is given in Figure 4. The largest bone appears to represent the anterior portion of the (left?) coracoid. The supposed glenoid region forms a lateral process and the two facets (glenoid and scapular) are not neatly defined; the line of the glenoid facet is confluent with the line of the scapular facet, as is also seen in immature *Cryptoclidus* (Andrews 1895, Fig. 3B). The coracoid is less wide posterior to the glenoid region. By following the curvature of the lateral border it seems likely that there would have been a lateral expansion of the coracoid into cornuae as seen in cryptocleidoid plesiosaurs. A thickened area is taken here to be the medial symphysis, but this area has suffered from crushing.

Limb

Von Huene identified the one preserved limb of MGUH 28378 as a femur and attempted to identify its associated podial elements. The propodials of plesiosaurs are often very similar but they can be differentiated from the position of the tuberosity/ trochanter on the head; this is situated directly above the epipophysis on the femur, but displaced posteriorly in the humerus (Brown 1981). Unfortunately this is not possible to determine in the Greenland specimen because the epipophysial region had suffered from crushing. However, this bone is most likely to be a humerus based on the relative position of the propodial.

Discussion

Ontogeny

The development of the skeleton indicates that this is an immature individual. The neural arches are preserved in place but they are not fused to the centra and are slightly displaced in some vertebrae. Similarly, the cervical ribs are not fused to the centra and the poorly defined glenoid/scapular facets of the coracoid are another immature characteristic. Based on the reconstruction of the pectoral girdle (Fig. 4), the scapulae do not appear to have met along their midline – this character is subject to ontogenetic variation – in *Cryptoclidus* the scapulae are known to be separate in young individuals, but met as the animal matured (Andrews 1895). The distal end of the humerus is not particularly flared in MGUH 28378, another possible indicator of immaturity. The immature nature of this specimen has implications for determining the taxonomic identity of the specimen (Brown 1981).

Taxonomic identification

Von Huene identified MGUH 28378 by comparing its 'pelvic girdle' with other plesiosaurs; he reasoned closest similarity with *Apractocleidus teretipes* (Smellie 1916). '*Apractocleidus*' is today considered a *nomen dubium*: a junior synonym of *Cryptoclidus* (Brown 1981). In any case, in light of the reidentification of these 'pelvic' bones as pectoral girdle elements, the identification is questionable and the validity of the specimen must be reassessed.

The plesiosaurian nature of this specimen is corroborated by its diagnostic plate-like girdle elements and the presence of nutritive foramina on the ventral/lateral surface of each centrum body (Sues 1987). A pliosauroid affinity can be discounted – the vertebrae of the superfamily Pliosauroidea are foreshortened and their neural spines are usually angled backwards (O'Keefe 2001). To the contrary, the proportions of the cervical vertebrae in MGUH 28378 are indicative of the superfamily Plesiosauroidea.

The presence of single-headed ribs was once used in plesiosaur systematics to define the 'cercidopleura', but this character is no longer considered taxonomically reliable (Brown 1981) and is known to be a convergent character (O'Keefe 2001). However, the high neural arches having zygapapophysis positioned far from the centrum are typical of cryptoclidid plesiosaurs (Brown 1993); large posterior cervical prezygapophysis with rounded edges are also typical of cryptoclidid plesiosaurs, including *Cryptoclidus* (see Andrews 1910, text-fig. 80, p. 171) and *Tricleidus* (Andrews 1910, plateVIII, fig. 8b). The distinct kink in the cervical ribs of the Greenland specimen (Fig. 3B) and circular rib facets, are also seen in *Tricleidus.* However, caution must be taken when using vertebral characters for taxonomic purposes because they differ along the vertebral column. The separated scapulae contrast with the condition in all other known cryptoclidids where the scapulae meet along a long symphysis in adults but this is subject to ontogenetic variation – if valid, this character is more similar to elasmosaurids amongst plesiosauroids.

Consequently, the Greenland specimen does not preserve any diagnostic characters beyond the family level, partly because of its incompleteness, and partly because it is an immature individual. Based on the characters described above (notably the proportions of the vertebrae and form of the cervical ribs) MGUH 28378 should be regarded as Cryptoclididae *indet.* The species *aldingeri* is therefore unsupported by any autopomophies and remains a *nomen dubium*.

Taphonomy and depositional setting

The vertebral column is preserved in articulation and the pectoral girdle elements are roughly in life position, associated together in the pectoral region. This preservation implies a low to medium energy environment, perhaps with slight currents responsible for the partial dissociation of some elements. A small number of epibionts can be observed *in situ* on the vertebral centra in the pectoral region. These appear to be bivalves, but are insufficiently preserved to allow further identification. According to von Huene (1935) part of the specimen was found on the beach, in the water, and so one should not overlook the possibility that these epibionts may be Recent. Otherwise, the fossil bones are free of encrusters and there is no evidence of scavenging by macro- or micro-organisms. The dark, finely laminated shale is void of any bioturbation and is typical of anoxic environmental conditions. This would explain the general lack of epibionts and benthic invertebrates associated with the remains. The specimen has suffered from crushing during diagenesis. This is particularly noticeable on the head of the humerus, the posterior process of scapula, the proximal end of one cervical rib (Fig. 3) and the coracoid symphysis.

Backwards-plesiosaurs

It is intriguing that this specimen was originally interpreted backwards – can any explanation be found to justify this basic fundamental error? The mistake exemplifies the morphological similarity between the pectoral and pelvic girdles of plesiosaurs; in fact, plesiosaur girdle elements are historically prone to misidentification. For example, Hector (1874) misidentified the pubis of *Mauisaurus* as the coracoid; Brown (1913) mistook the scapula of *Leurospondylus* for an ischium; and Tarlo (1957, 1959) misinterpreted the ilium of a pliosaur as a scapula (Halstead [=Tarlo] 1989), upon which he created the novel genus '*Stretosaurus*'. *Cryptoclidus aldingeri* is therefore one more plesiosaur, in an unusually long line, to be affected by an anatomical misinterpretation. The position and orientation of plesiosaur propodials, when preserved in articulation, are usually swept backwards. However, in MGUH 28378, the limb is angled slightly forward. Maybe this unusual preservation also influenced von Huene's opinion?

Dansk sammendrag

I 1935 beskrev Friedrich von Huene et ukomplet skelet af en plesiosaur fra Milne Land i Østgrønland som holotypen for en ny art, *Cryptoclidus (Apractoclidus) aldingeri*. Stykket blev imidlertid tolket forkert og genbeskrives i denne artikel som skulderbæltet og den bageste del af halsen. Plesiosauren har ikke været fuldt udvokset, da skulderbladene viser tegn på at have været adskilt fra hinanden, og overarmsknoglen ikke bliver synderligt bredere distalt. Stykket er ikke diagnostisk til mere end familie-niveau, og betragtes derfor som Cryptoclididae indet.; arten *aldingeri* bliver derfor et *nomen dubium*.

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