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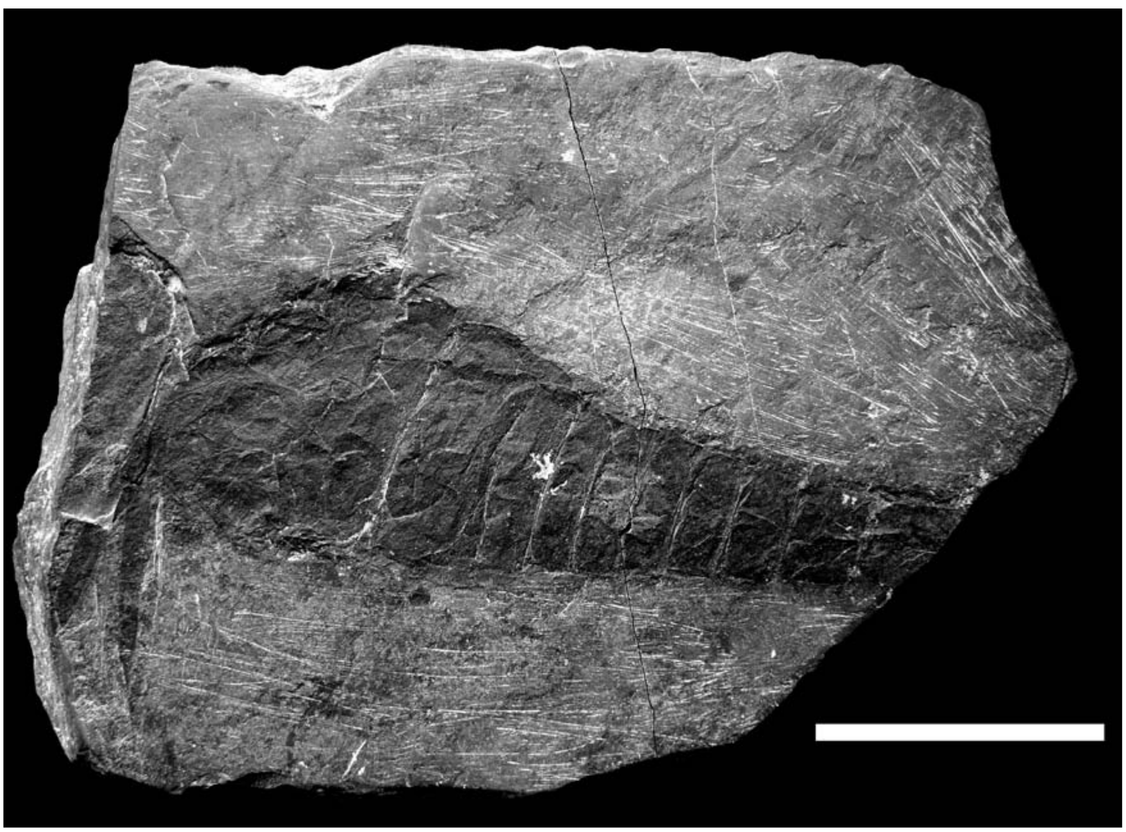
Volume 9 Number 6



GEOLOGICAL CURATORS' GROUP

Registered Charity No. 296050

The Group is affiliated to the Geological Society of London. It was founded in 1974 to improve the status of geology in museums and similar institutions, and to improve the standard of geological curation in general by:

- holding meetings to promote the exchange of information
- providing information and advice on all matters relating to geology in museums
- the surveillance of collections of geological specimens and information with a view to ensuring their well being
- the maintenance of a code of practice for the curation and deployment of collections
- the advancement of the documentation and conservation of geological sites
- initiating and conducting surveys relating to the aims of the Group.

2011 COMMITTEE

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Cover: DONMG:ZG2316. *Erettopterus bilobus*. Relatively complete specimen. Scale bar = 10 cm.. See paper by Lomax *et al*. inside.

THE GEOLOGICAL CURATOR

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CONTENTS

A COLLECTION OF EURYPTERIDS FROM THE SILURIAN OF LESMAHAGOW COLLECTED PRE 1900

by Dean R. Lomax, James C. Lamsdell and Samuel J. Ciurca, Jr

Lomax, D.R., Lamsdell, J.C. and Ciurca, S.J. Jr 2011. A collection of eurypterids from the Silurian of Lesmahagow collected pre 1900 . *The Geological Curator* 9 (6): 331 - 348.

A rediscovered collection of scientifically significant eurypterid fossil specimens, assigned to *Slimonia acuminata* and *Erettopterus bilobus*, is held in the Doncaster Museum and Art Gallery. The specimens are from the historically important late Silurian Lesmahagow inlier of Lanarkshire, Scotland and are described herein. The material ranges from partial to complete specimens, with a wide range in size of both genera. Most specimens have either no or minimal damage. Some interesting features include the orientation and preservation of the eurypterids.

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Introduction

Eurypterids, commonly referred to as "sea scorpions", represent a group of extinct Palaeozoic (late Ordovician to the late Permian) aquatic chelicerate arthropods, known from at least 200 species (Tetlie 2007). The first eurypterid was described by DeKay (1825) from the Silurian of North America, while the first recognised specimens from the United Kingdom were discovered by quarrymen in Scotland (Salter 1856). Eurypterid fossils are found around the world, although complete eurypterids are rare with body and appendage fragments often the only parts preserved (Selden 1984). They include the largest arthropods to have ever lived, the pterygotids (Braddy *et al.* 2008), which may have attained such sizes through competition with armoured fish (Lamsdell and Braddy 2010).

The importance of old or misplaced/recovered collections to current research on all aspects of eurypterid palaeobiology has been noted in recent publications. Lost holotypes are often necessarily replaced by material preserved in museum collections, thus specimens such as this recovered collection are important (Tetlie and Rabano 2007 and Tetlie *et al.* 2007). This paper briefly describes 23 eurypterid specimens held in the palaeontology collection at Doncaster Museum and Art Gallery, discusses how the fossils were acquired by the museum their original donor and details of their probable provenance and history. Each specimen is also briefly described.

History of the eurypterid collection

The eurypterids and a few phyllocarid specimens were donated to the Doncaster Museum and Art Gallery in the 1960s by the Dick Institute in Kilmarnock, Scotland (C. Howes, pers. comm. 2010). They were part of a larger private collection donated to the Dick Institute in the late 1890s by Dr Hunter-Selkirk for its opening in April 1901. In 1963-64 the Dick Institute donated a relatively small collection of natural history specimens to the newly formed Doncaster Museum and Art Gallery (previously Beechfield House Museum) including bird skins and animal remains that were catalogued into the museum's ever growing collection.

Unfortunately, no written recollection (bar a few minor labels) of the eurypterids was catalogued into the museum's collections, but it appears that the eurypterids were donated in 1963-64 and remained uncatalogued due to a shortage of specialised staff. A small minority of the eurypterid specimens have their original labels from the Dick Institute, some of which include the name of Dr Hunter-Selkirk.

John Hunter-Selkirk was a prolific collector and fossil hunter who amassed a large collection of fossils, antiquities and early printed books (Macnair and Mort 1908). Perhaps Selkirk's most important fossil held in his collection was the Scottish Silurian scorpion; *Allopalaeophonus caledonicus* previously described as '*Palaeophonus hunteri*' (Dunlop *et al.* 2011), held in the Dick Institute (formally the

Kilmarnock Museum) (Pocock 1901). Specimens such as *A. caledonicus* have been prepared in the exact same way as those held in the collection at Doncaster Museum; they have white markings spread around the entire edges of the matrix, probably chisel markings and which also suggests they were originally part of the same collection (D. Lomax, personal observation). Dr Hunter-Selkirk's collection (known as the 'Braidwood Collection') was touted as one of the most important private collections brought together in this country by one individual (Macnair and Mort 1908), and his donation of major portions of his large collection to the town was instrumental in the establishment of a museum in Kilmarnock.

Geological Setting and Age

The collection of eurypterid specimens has very little data accompanying it. A few of the specimens have brief descriptions and basic locality information; some do include remarks to the localities of Logan Water, Muirkirk/Lesmahagow and the age identified as the Upper Ludlovian (Ludlow Series). Many important Silurian fossils have been discovered near the Lesmahagow inlier in Lanarkshire, Scotland and surrounding region. The inlier is a palaeontologically significant exposure containing an array of rare, important vertebrate and arthropod fossils and exposes a section of Silurian sediments dating to the Upper Llandovery and Wenlock ages (Phillips 2007) surrounded by sediments of Carboniferous age. It consists of shales, sandstones and occasional pebble conglomerates (Rolfe 1992) and it is most probable that the eurypterid specimens were derived from this locality.

Although the eurypterid specimens were initially tentatively identified as being Ludlow in age the entire collection of specimens derive from either the Llandovery or Wenlock stages of the Silurian Period. Most of the Lesmahagow eurypterid fossils have come from the Kip Burn and Patrick Burn Formations (Rolfe 1992) both of which have yielded the eurypterid genera identified in the collection.

Almost all of the eurypterid specimens are preserved as dark (carbonaceous) structures in a dark, almost black siltstone matrix similar to the lithology of both formations (Rolfe 1992, Tetlie and Braddy 2004). However, both DONMG:ZG2326 and DONMG:ZG2327 have a predominantly red-brown to pinkish brown colour that may be due to their having been exposed to a fire, it is possible that these specimens were caught in the fire that burnt down the Dick Institute in 1909.

Systematic Palaeontology

General eurypterid terminology follows Tollerton (1989) and Selden (1981), with denticle terminology following Miller (2007).

Order EURYPTERIDA Burmeister, 1843
Suborder EURYPTERINA Burmeister, 1843
Superfamily PTERYGOTOIDEA Clarke & Ruedemann, 1912
Family PTERYGOTIDAE Clarke & Ruedemann, 1912
Genus ERETTOPTERUS, Salter in Huxley & Salter 1859
Species BILOBUS Salter, 1856

Description
A total of ten specimens have been attributed to *Erettopterus bilobus*.

DONMG:ZG25 and DONMG:ZG2303 - Figure 1 and Figure 2. Part and counterpart. Isolated pair of complete pterygotid chelicerae, each consisting of fixed and free ramus and elongate basal podomere (peduncle). The rami of both appendages preserve fine detail of the denticles and correspond well to the denticulation patterns of *Erettopterus bilobus* as reconstructed by Waterston (1964). The fixed ramus has an angular terminal denticle and up to five principle denticles with no denticles on the base of the ramus, while the free ramus has a more rounded terminal denticle and three principle denticles that align with the central three principle denticles on the opposing ramus. The principle denticles on both appendages show excessive wear. The uppermost appendage measures 19.5 cm in length and 2.7 cm at its widest point. The lower appendage is positioned slightly more ventral to the upper, measuring 20.5 cm in length with a maximum width of 2.3 cm.

DONMG:ZG26 - Figure 3. A nearly complete specimen with 12 opisthosomal segments preserved along with the base of the telson with probable median carina. Displaced type B genital appendage is visible underlying the third segment; more narrow than in *Erettopterus osiliensis* (Ciurca and Tetlie 2007); it is viewed dorsally so that the lateral flange is completely exposed. The anterior section of the specimen consists of fragments of doublure, carapace and appendages. The basal segments of two enlarged chelicerae are angled to the right. The carapace is displaced and positioned anteriorly, exposing the coxae in their original arrangement. At least four other appendages are also preserved. Appendage VI is poorly preserved and appears to be of a modified *Hughmilleria*-type, with the median groove running

Figure 1. DONMG:ZG25. **Erettopterus bilobus***. Specimen showing paired chelicerae. Scale bar = 10 cm.*

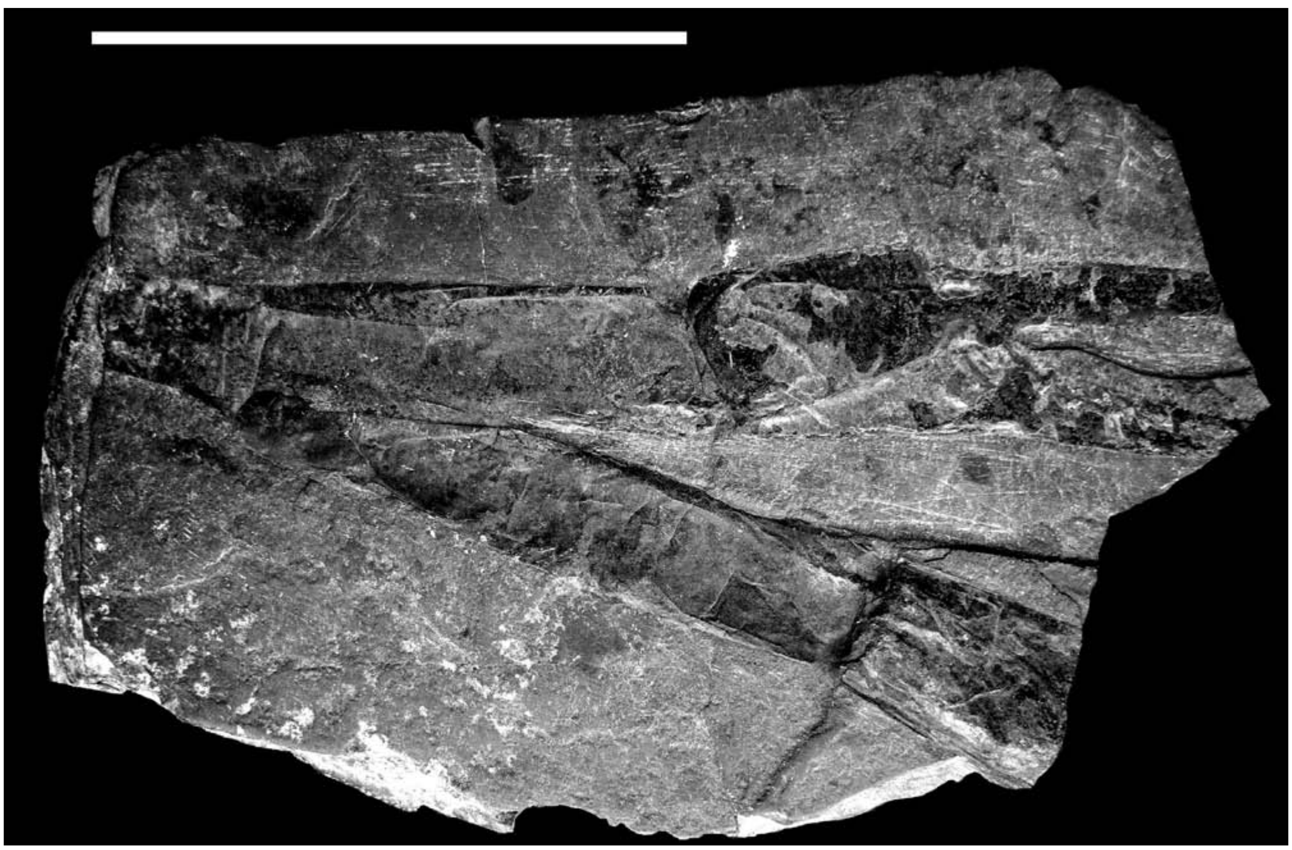

Figure 2. DONMG:ZG2303. **Erettopterus bilobus***. Counterpart to DONMG:ZG25. Scale bar = 10 cm.*

up podomere 7 similar to that in *E. osiliensis*. Three narrow, non-spiniferous appendages (that do not correspond to any appendage type in the system of Tollerton, 1989) are located anterior to the paddle, gracile in aspect and preserved flexed back against the prosomal region. The specimen is 12.6 cm long, with a maximum width of 2.4 cm. The largest and longest appendage (one of the chelicerae) has a total length of 3.2 cm and width of 0.5 cm.

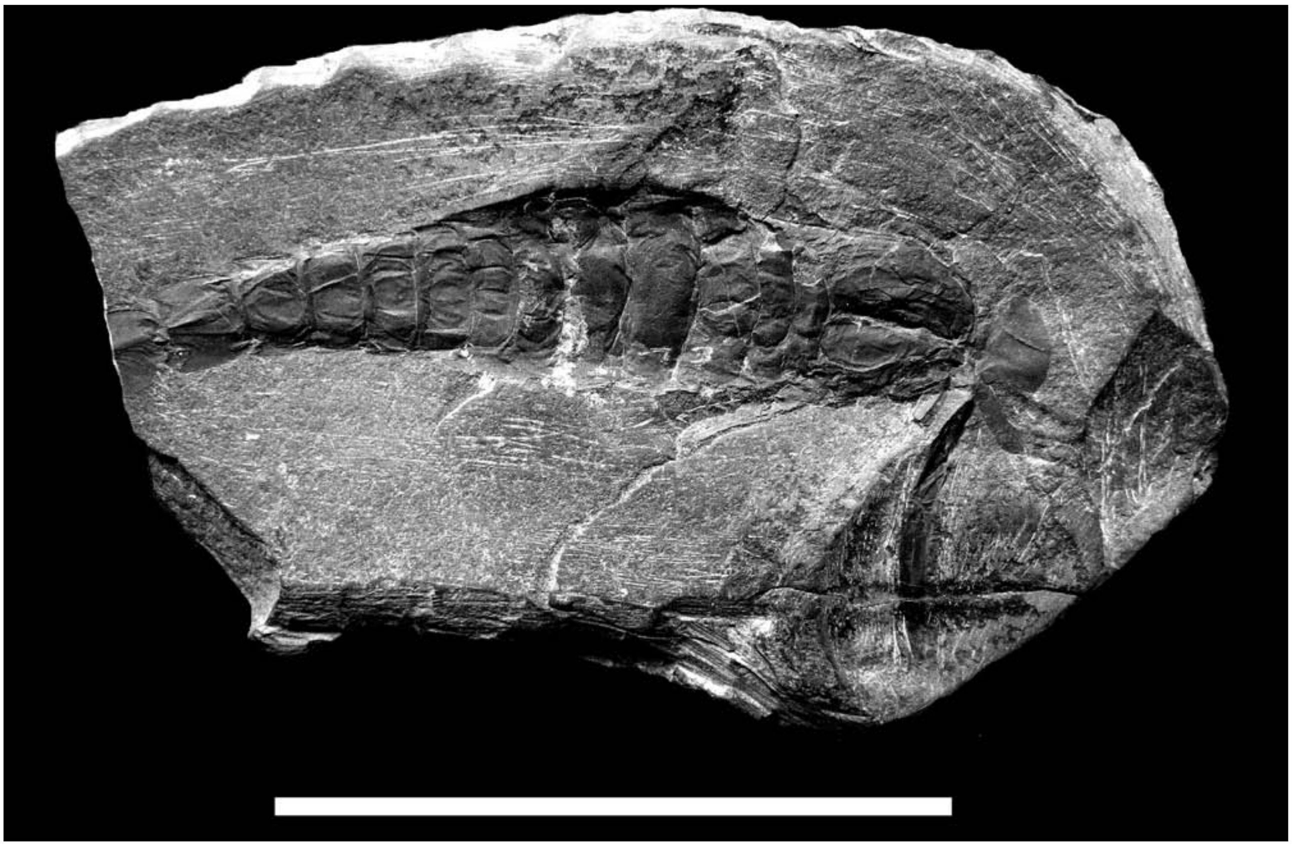

Figure 3. DONMG:ZG26.* Erettopterus bilobus*. Relatively complete specimen. Scale bar = 10 cm.

DONMG:ZG2305 - Figure 4. Complete specimen with prosomal region, 12 tergites and a bilobed telson. The first tergite is reduced compared to the others, while the metasomal segments have paired striations running down their length with segments 11 and 12 also possessing a median carina. The mesosoma is broad and rather squat, a characteristic of *E. bilobus*, while the carapace is semi-circular and preserves two large lateral eyes, oval in shape and positioned antero-marginally. Both paddles are present, resembling those of *E. osiliensis*, while at least two of the small, gracile appendages are preserved curving backwards. The enlarged chelicerae are reversed, with the fixed and free rami positioned closest to the carapace. The length of the specimen (curved) is 12 cm and would be approximately 13.5 cm if straight, with a maximum width of 2.8 cm. The most anterior appendage pair have lengths of 4.2 cm and 4 cm with widths of 0.3 cm and 0.4 cm respectively. The uppermost swimming leg measures 2 cm in length and 0.3 cm in width while the lower swimming leg is 1.5 cm long and 0.4 cm wide.

DONMG:ZG2306 - Figure 5. Near complete specimen with whole broad body, missing only the most distal end of the telson, with both swimming legs preserved and possible eyes. The telson appears bilobed but is mostly lost although carinae are present on both the telson and pretelson. The genital appendage is faintly preserved, and appears to be of type B. Prosoma poorly preserved, doublure of *Pterygotus*-type with epistomal plate missing, suggesting that the specimen represents an exuvium. Coxae VI preserve gnathobases and both paddles are preserved, the left appendage better than the right. The margin of podomere 8 is somewhat serrated, and in general morphology they correspond well to *E. osiliensis*. The matrix is reddish-brown in the centre, although the general colour of the surrounding matrix is grey. It measures 13.6 cm in length with a maximum width of 3.6 cm. Swimming legs measure 3.2 cm and 2.9 cm in length with widths of 0.5 cm and 0.6 cm respectively.

DONMG:ZG2311 - Figure 6. Nearly complete specimen lacking appendages. Body elongate with a gentle curvature at the metasoma. The opisthosoma preserves all 12 segments and the bilobed telson with carina, also present on the two posterior segments. The majority of the prosoma is missing and only a minor section of the chelicerae is preserved. The specimen is 15.5 cm long with a maximum width of 4 cm. The incomplete appendage length is 1.2 cm with a width of 0.7 cm.

DONMG:ZG2315 - Figure 7. Almost complete specimen. The body is broad, with paired striations on the postabdomen. The carapace is fragmentary with faint

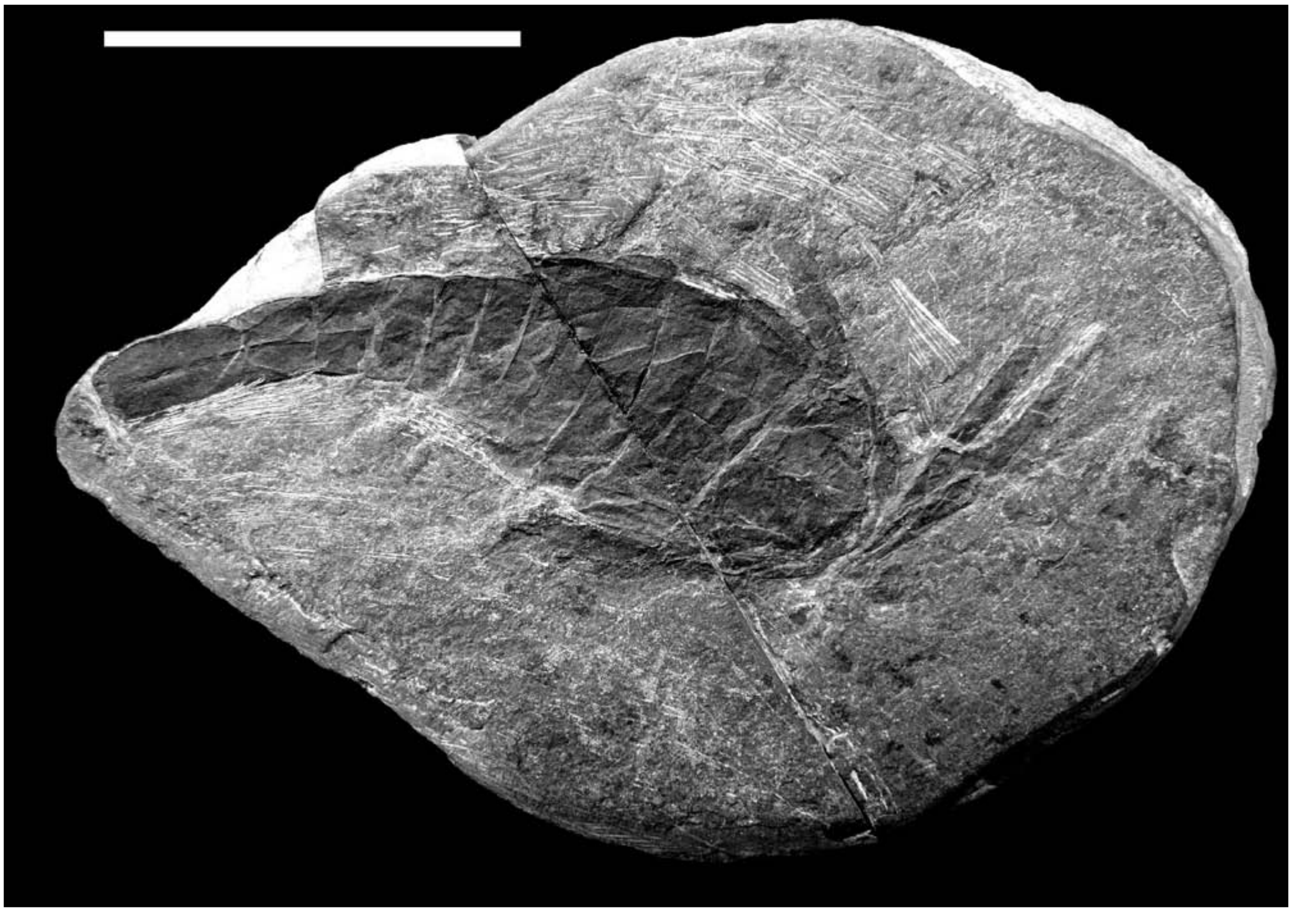

Figure 4. DONMG:ZG2305. **Erettopterus bilobus***. Complete specimen with chelicerae disarticulated and reversed. Scale bar = 10 cm.*

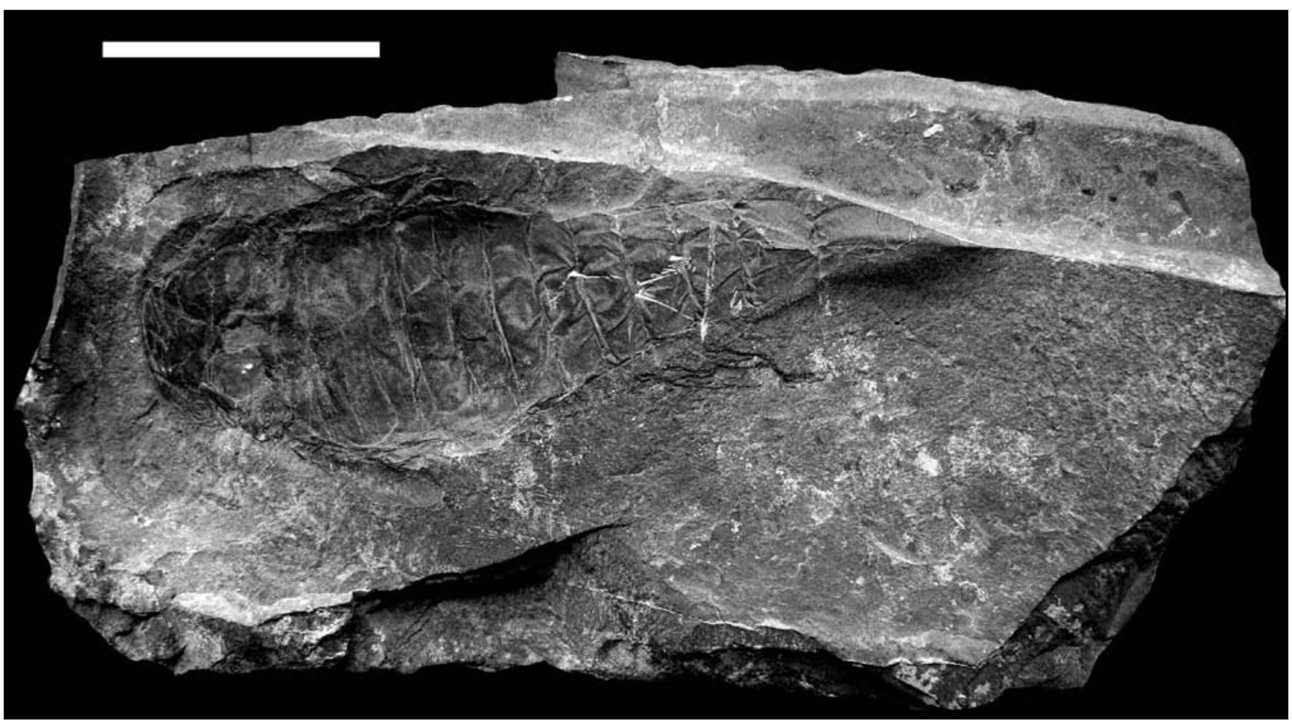

Figure 5. DONMG:ZG2306. **Erettopterus bilobus***. Relatively complete specimen showing detail of the swimming paddles. Scale bar = 10 cm.*

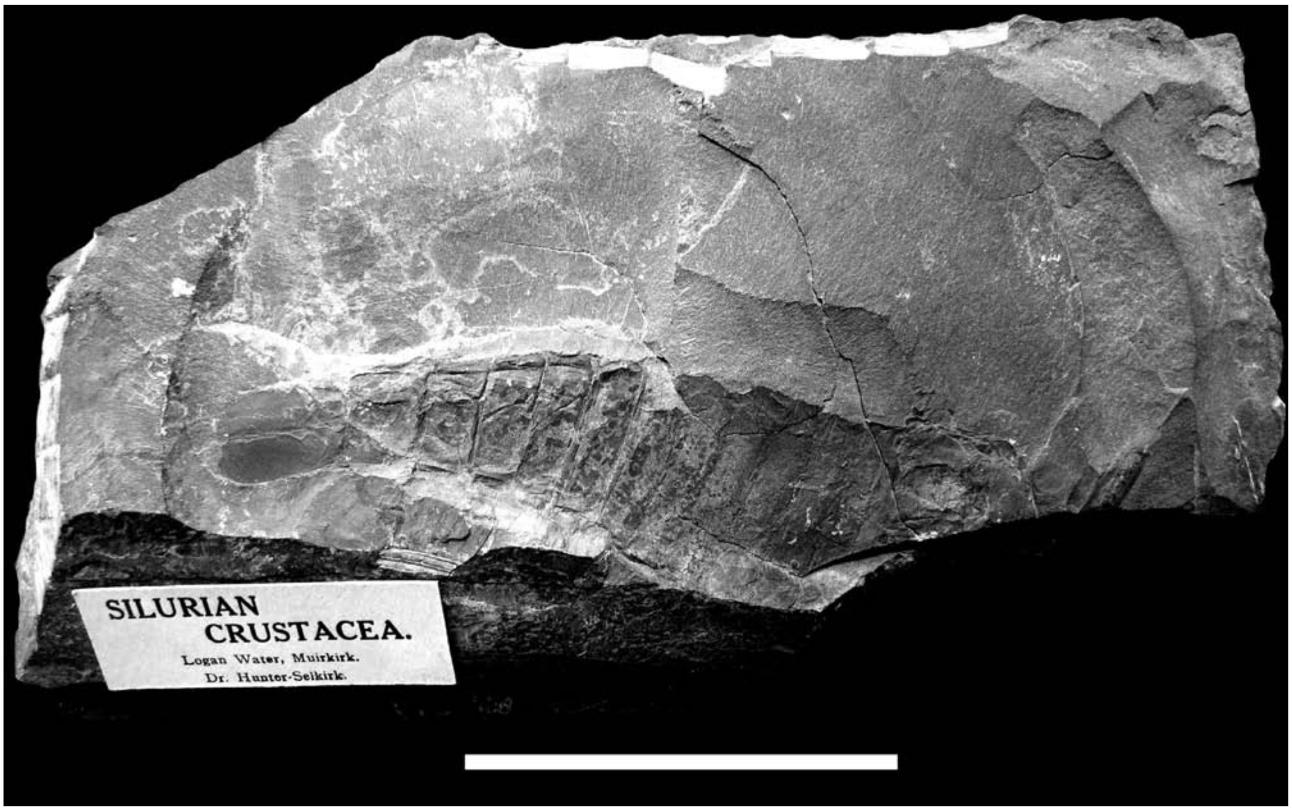

Figure 6. DONMG:ZG2311. **Erettopterus bilobus.** *Specimen showing opisthosoma and telson. Scale bar = 10 cm.*

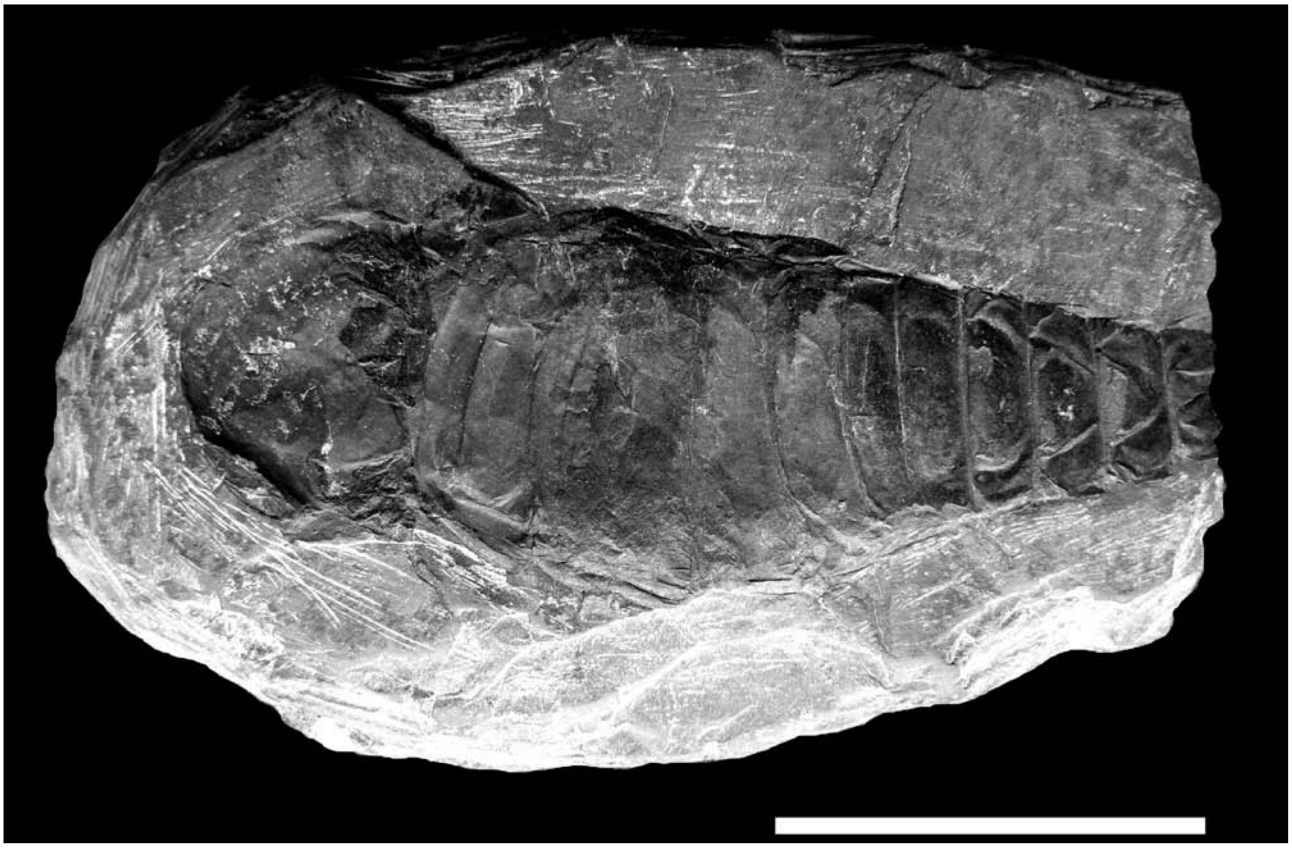

Figure 7. DONMG:ZG2315. **Erettopterus bilobus.** *Specimen showing paired folds or ridges on the metasoma. Scale bar = 10 cm.*

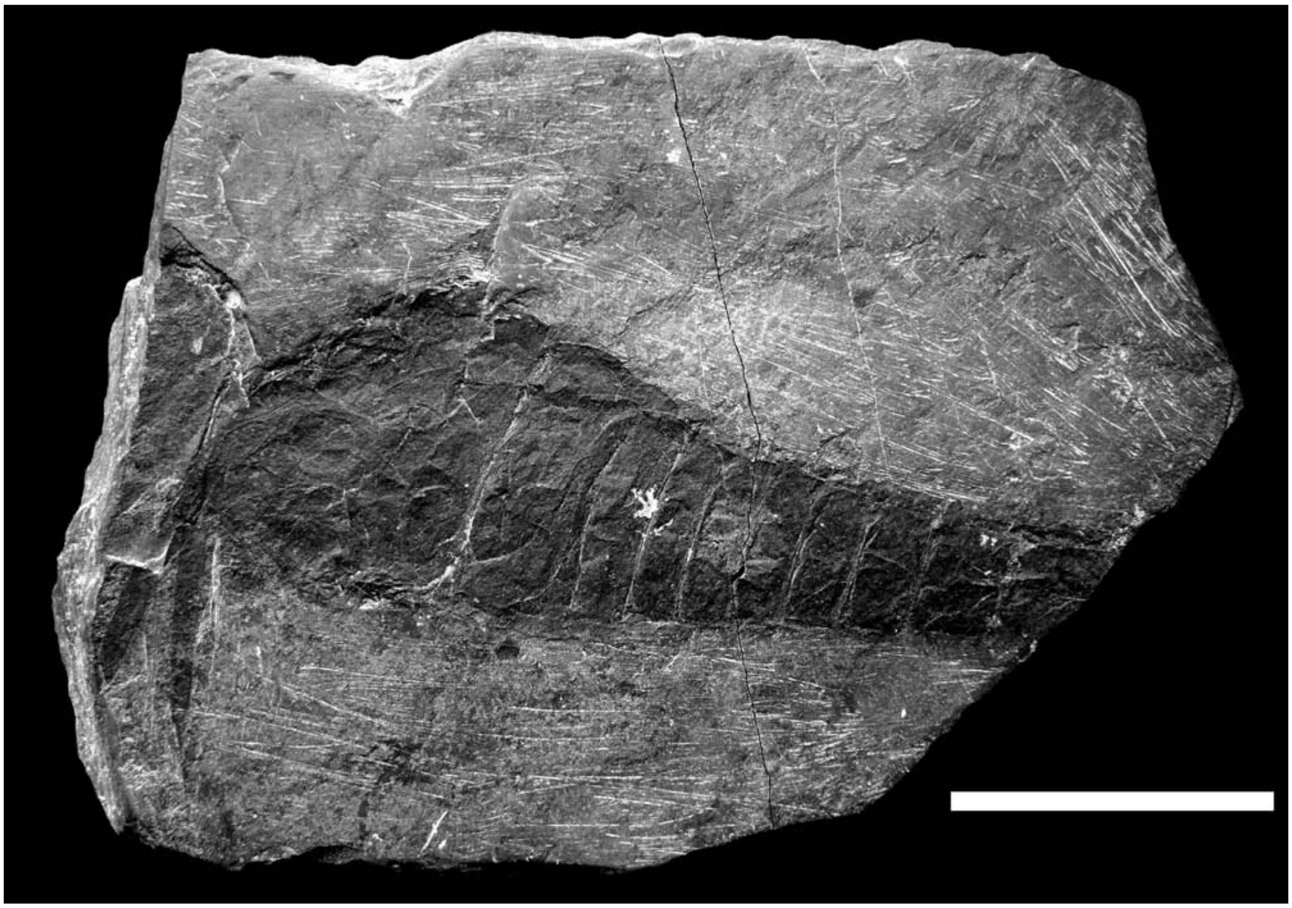

Figure 8. DONMG:ZG2316. **Erettopterus bilobus***. Relatively complete specimen. Scale bar = 10 cm.*

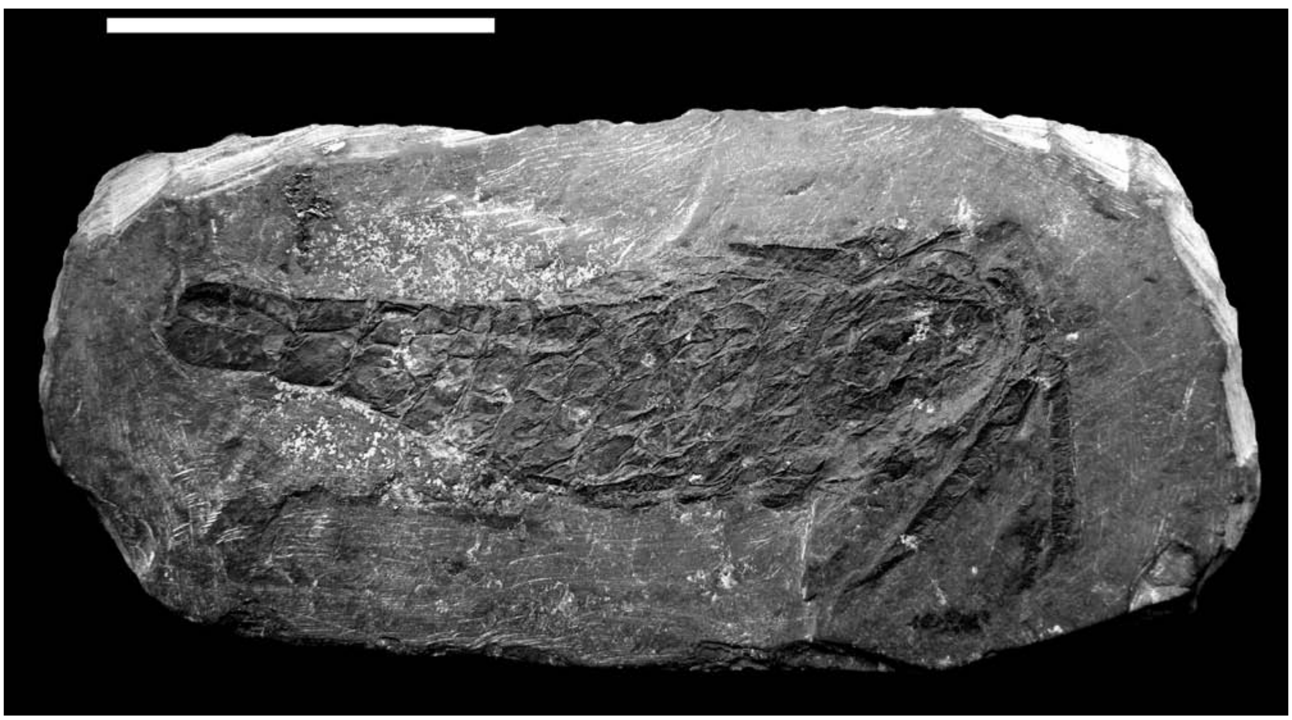

Figure 9. DONMG:ZG2319. **Erettopterus bilobus***. Almost complete specimen showing the vertical rudder on the telson. Scale bar = 5 cm.*

evidence of appendages, while the opisthosoma consists of 12 segments. The mesosoma is wide and bulky and the metasoma is elongate and tapers almost triangularly. The specimen is 11.3 cm long with a maximum width of 4.1 cm.

DONGM:ZG2316 - Figure 8. Unusually orientated, nearly complete specimen. The mesosoma is uneven along one side, perhaps due to it having been partially enrolled. A total of 12 tergites are preserved, with the mesosoma again broad and segment 11 and the

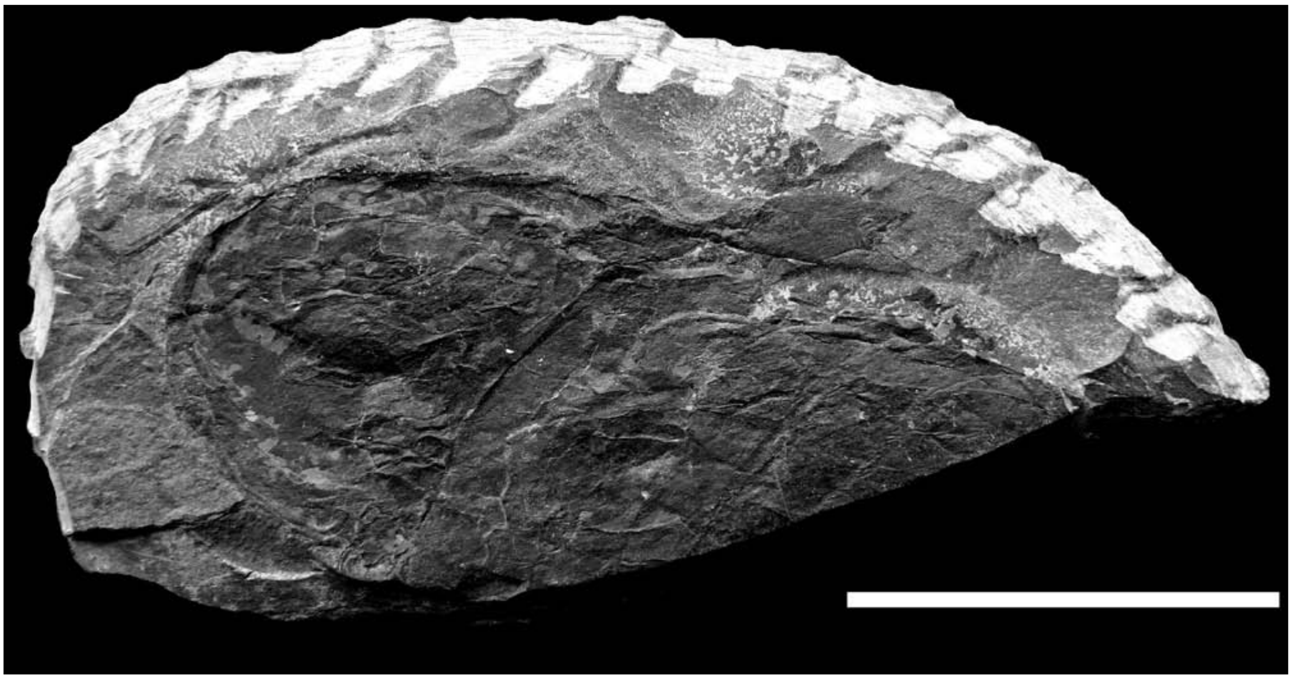

Figure 10. DONMG:ZG2322.* Erettopterus bilobus*. Specimen showing prosomal region and anterior mesosomal segments. Scale bar = 10 cm.

pretelson having carina. The proximal portion of the telson is also present, and it is straight sided and bears a median carina. The tergites have paired ridge-like striae throughout, distinct from the elongate nodules of *Slimonia*. The prosomal region is poorly preserved, however an oval metastoma can be seen as can the proximal portion of two enlarged chelicerae. The total body length is 13.3 cm with a maximum width of 4.3 c. The appendage lengths are 3.2 cm and 3.5 cm with widths of 0.3 cm and 0.3 cm respectively. The specimen is in two separate sections; repair may be necessary.

DONMG:ZG2319 - Figure 9. Complete specimen with a total of 12 tergites and prosomal region preserved. The body is broad through the mesosoma. Gnathobases of coxae are present in the prosomal region while the distal portions of the paddles are preserved either side, one with slight serrations on podomere 7. Large chelicerae are clearly preserved

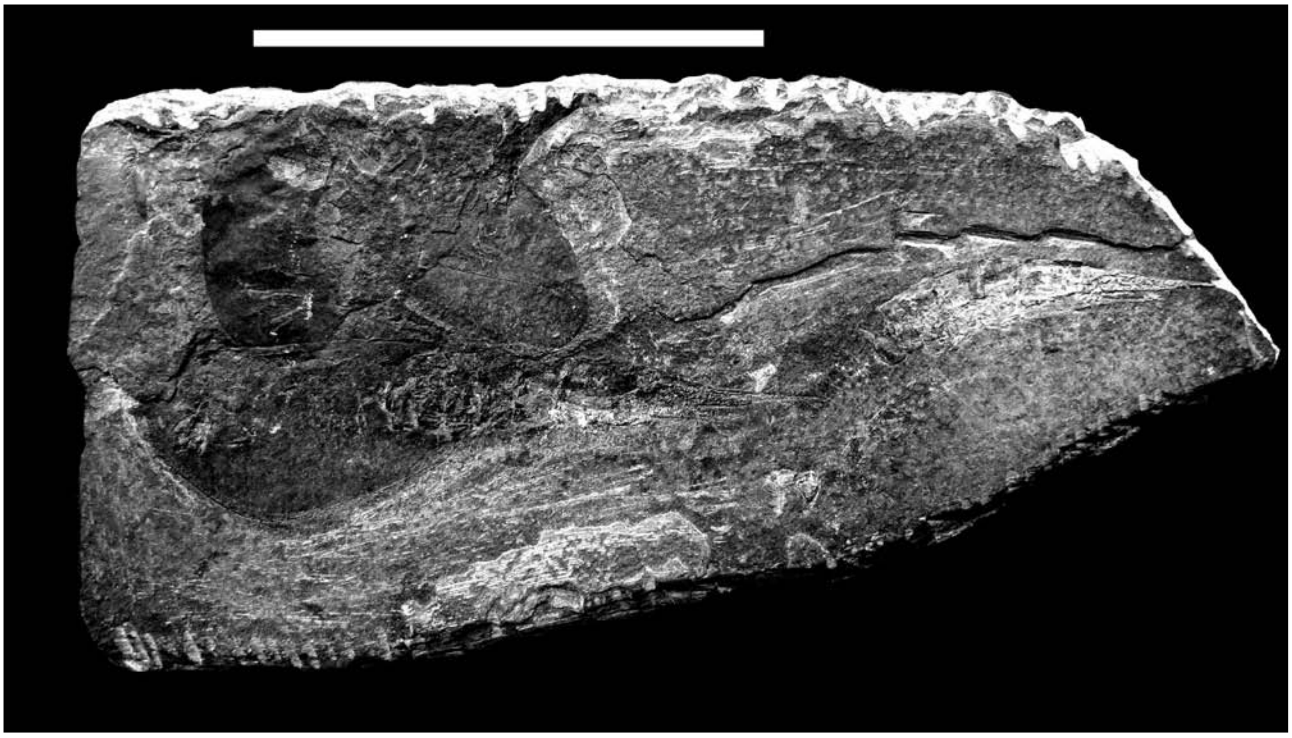

Figure 11. DONMG:ZG2323.* Ceratiocaris *sp. and* Erettopterus bilobus*. Specimen showing* Ceratiocaris *in dorsal view with* Erettopterus *coxa. Scale bar = 10 cm.

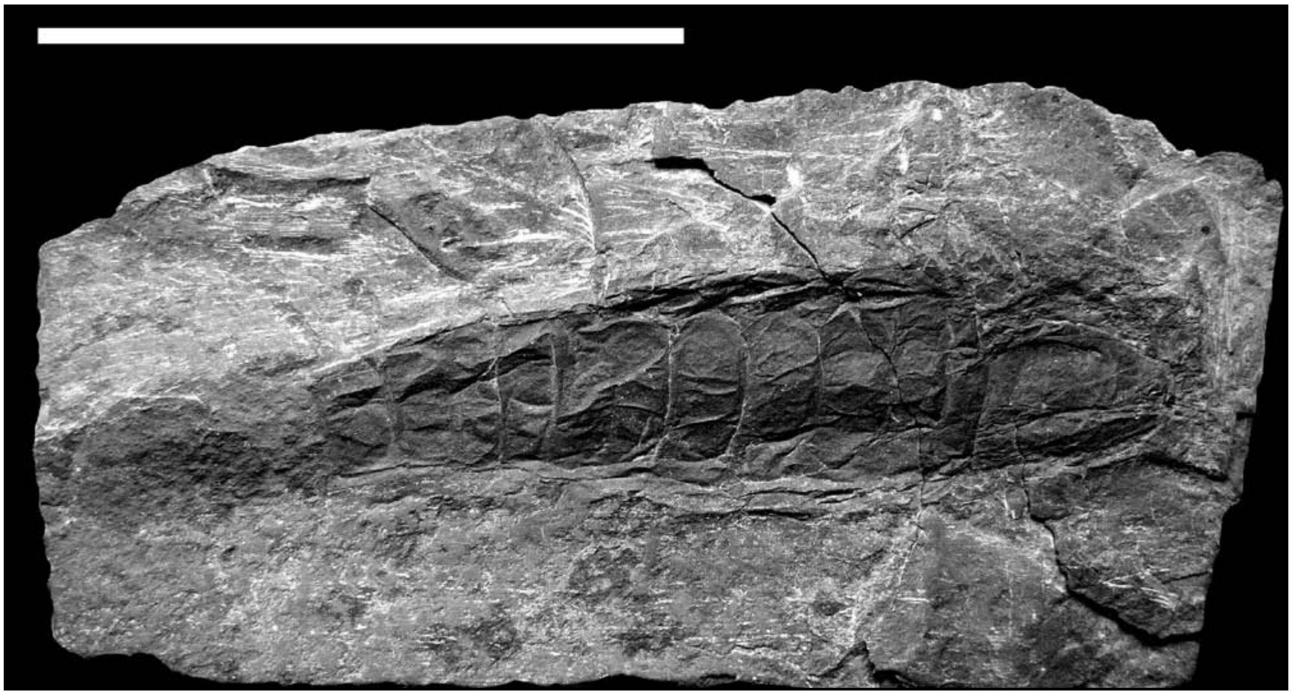

Figure 12. DONMG:ZG2324.* Erettopterus bilobus*. Laterally compressed specimen. Scale bar = 10 cm.

anteriorly, displaced towards the right. The telson is bilobed and shows a median vertical rudder folded over towards the left side. The entire length of the specimen is 11.5 cm with a maximum width of 2.8 cm. The appendages lengths are is 2.8 cm and 3.4 cm with widths of 0.3 cm and 0.3 cm respectively.

DONMG:ZG2322 - Figure 10. Small incomplete specimen; only the prosomal region and anterior mesosomal segments are preserved. The right paddle is preserved but with individual podomere boundaries indistinct. Striate ornamentation along the posterior of tergites indicates this specimen is also assignable to *E. bilobus*. The length of the specimen is 9.8 cm with a width of 4.1 cm.

DONMG:ZG2323 - Figure 11. Block matrix largely consisting of *Ceratiocaris*, however alongside there is an anterior gnathobasic portion of coxa (probably coxa VI) pertaining to *E. bilobus*.

DONMG:ZG2324 - Figure 12. Nearly complete specimen with 11 opisthosomal segments preserved, however the telson and pretelson are absent. The prosomal region is poorly preserved, although ventral impression of coxae VI and the oval shaped metastoma are present. The length of the specimen is 15 cm with a maximum width of 3 cm. A few minor cracks are apparent on the anterior section of the specimen.

Remarks

Erettopterus bilobus is an old species that has not received much attention since its original description and is ideally in need of revision accommodating a modern understanding of eurypterid systematics and evolution beyond the treatment received herein.

Lamsdell and Legg (2010) cautioned against the use of cheliceral denticulation for generic-level assignment, however denticulation patterns can be a good species-level character. The chelicerae held in the collection match those described for *Erettopterus bilobus* by Waterston (1964), and the bilobed telson found on a number of specimens confirms this assignment. Kjellesvig-Waering (1964) cited the presence of a vertical rudder in *E. bilobus* based off a single specimen in his personal collection, as discussed by Ciurca and Tetlie (2007). DONMG:ZG2319 confirms the existence of this structure in the species and corresponds well with the specimen figured by Kjellesvig-Waering.

The broad body of *E. bilobus* may indicate that many of these specimens are juveniles, as the opisthosoma of juvenile eurypterids tends to be comparatively broader than in adults (Andrews *et al.* 1974). While the broad nature of the mesosoma is less pronounced in larger specimens it is still comparatively broader than in *E. osiliensis* and so it seems that this may be a genuine trait of the species.

Family SLIMONIIDAE Novojilov, 1962
Genus SLIMONIA Page, 1856
Species ACUMINATA Salter, 1856

Description

A total of thirteen specimens are here attributed to *Slimonia acuminata*.

DONMG:ZG365 - Figure 13. The largest eurypterid specimen identified in the collection, almost complete but lacking a recognisable prosomal region. Consists of 10 opisthosomal segments (3-12), with the genital operculum preserved anteriorly, and the telson with its very distal end missing. The genital operculum (Fig 13.1) is reversed and of type A, bearing deltoid plates and the proximal segment of the genital appendage preserved with lateral flanges and a median groove that corresponds to the type A appendage of *S. acuminata* (Waterston 1960). The telson is foliate. The integument bears a pitted triangular-like pattern that corresponds well to the ornamentation of pterygotids. The mesosomal segments may show a median suture that would correspond to the fused ventral operculae, while the pretelson and telson have a median carina. The length of the specimen is 68 cm with a maximum width of 21.5 cm.

DONMG:ZG366 - Figure 14. Almost complete carapace with the preabdomen tapering dorsoventrally to the lower part of the matrix. The carapace is long rectangular in shape with a median constriction. The lateral eyes are oval and located anterolaterally. The carapace marginal rim is broad anteriorly between the lateral eyes but narrow posterior to the eyes along the lateral edge of the carapace. The anterior marginal rim is ornamented with pustules. A paddle is preserved at the top of the specimen, and another alongside it. Next to the lowermost paddle is another genital appendage of type A. The specimen - probably a moult - has a wrinkled exterior throughout the anterior portion of the carapace that indicates in life it was inflated. During the taphonomic stage of preservation, the weight of overlying sediments flattened the moult. The ornamentation is again pterygotid-like and paired elongated nodes run down the centre of the body. The anterior segment is reversed and also possesses the paired ridges. The body length of this specimen is 18 cm with a width of 11 cm. The pro-

Figure 13.1. DONMG:ZG365.* Slimonia acuminata*. Enlarged view of genital operculum. Scale bar = 10 cm.

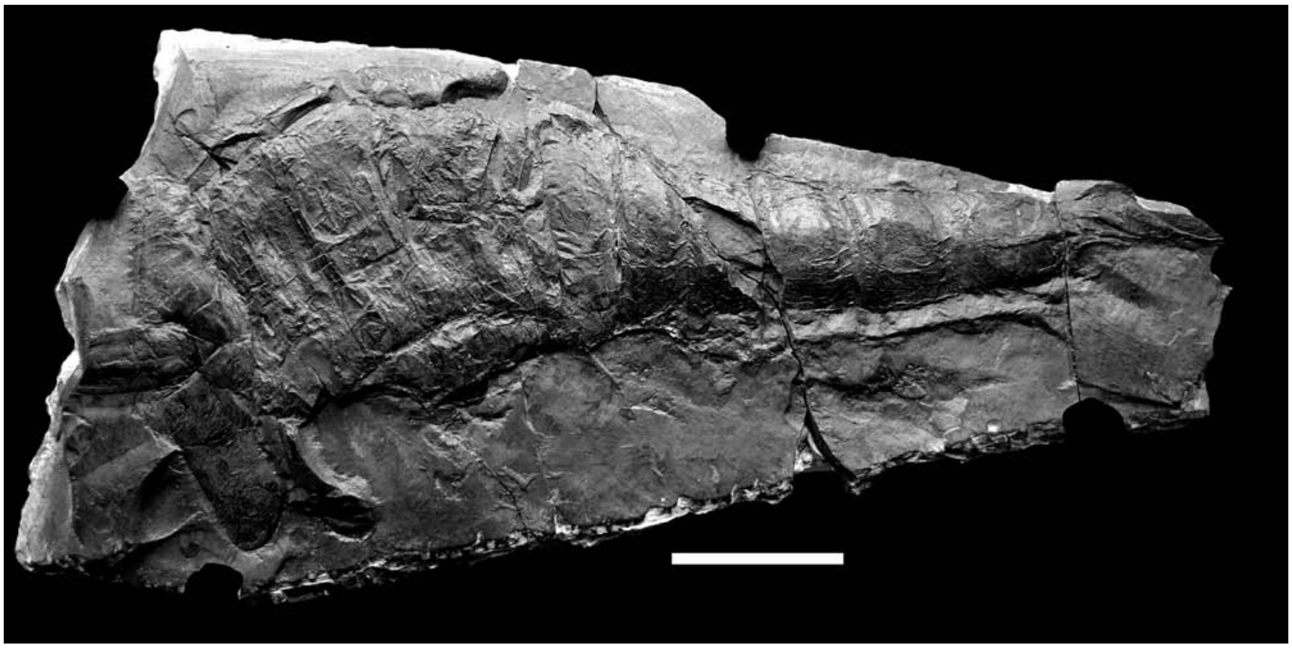

Figure 13. DONMG:ZG365. **Slimonia acuminata.** *Large specimen with reversed genital operculum. Scale bar = 10 cm.*

soma length is 21.1 cm with a width of 2 cm. The specimen is unusually orientated; possibly suggesting the specimen was transported prior to burial.

DONMG:ZG2304 - Figure 15. Well preserved carapace specimen. Carapace is long rectangular shaped. Both oval shaped lateral eyes are preserved in the anterolateral corners and are elongate, measuring over 1 cm. The anterior marginal rim is ornamented by pustules that appear to form two rows offset from one another, with pits on the carapace posterior to the marginal rim. The carapace has been flattened, and in life the centre was inflated as shown by the wrinkling of the cuticle. The carapace has a length 11 cm with a width of 10 cm.

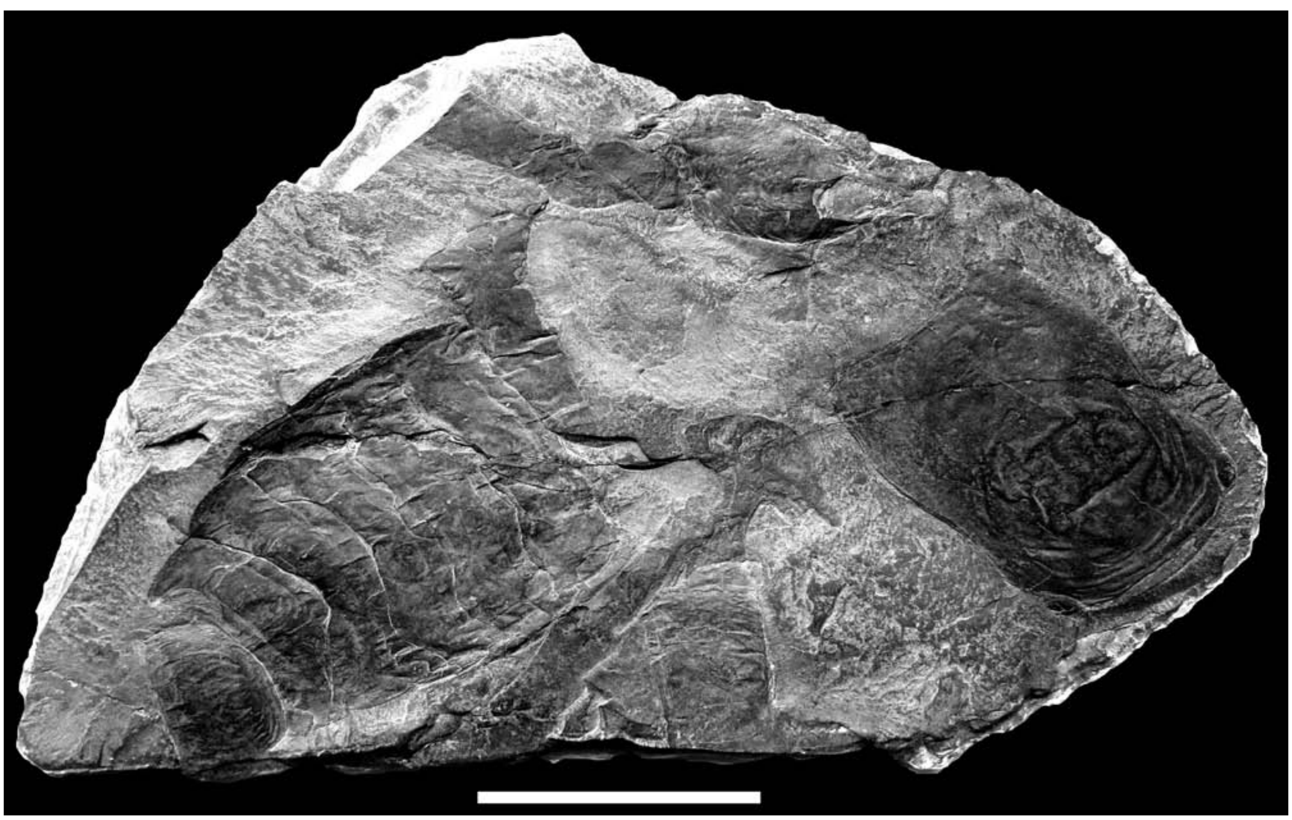

Figure 14. DONMG:ZG366. **Slimonia acuminata.** *Disarticulated specimen showing ornamentation of the tergites. Scale bar = 10 cm.*

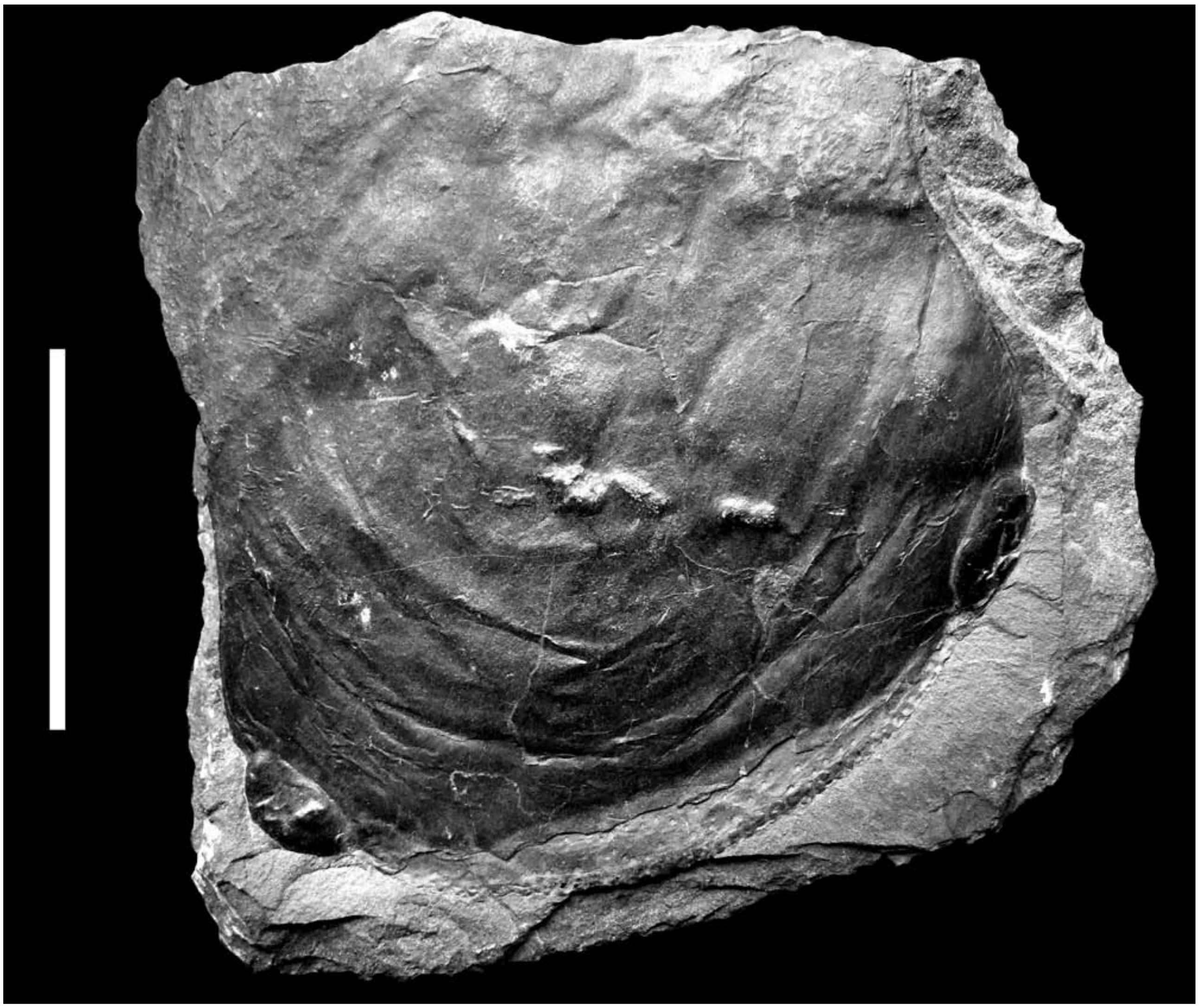

Figure 15. DONMG:ZG2305. **Slimonia acuminata***. Isolated prosoma. Scale bar = 10 cm.*

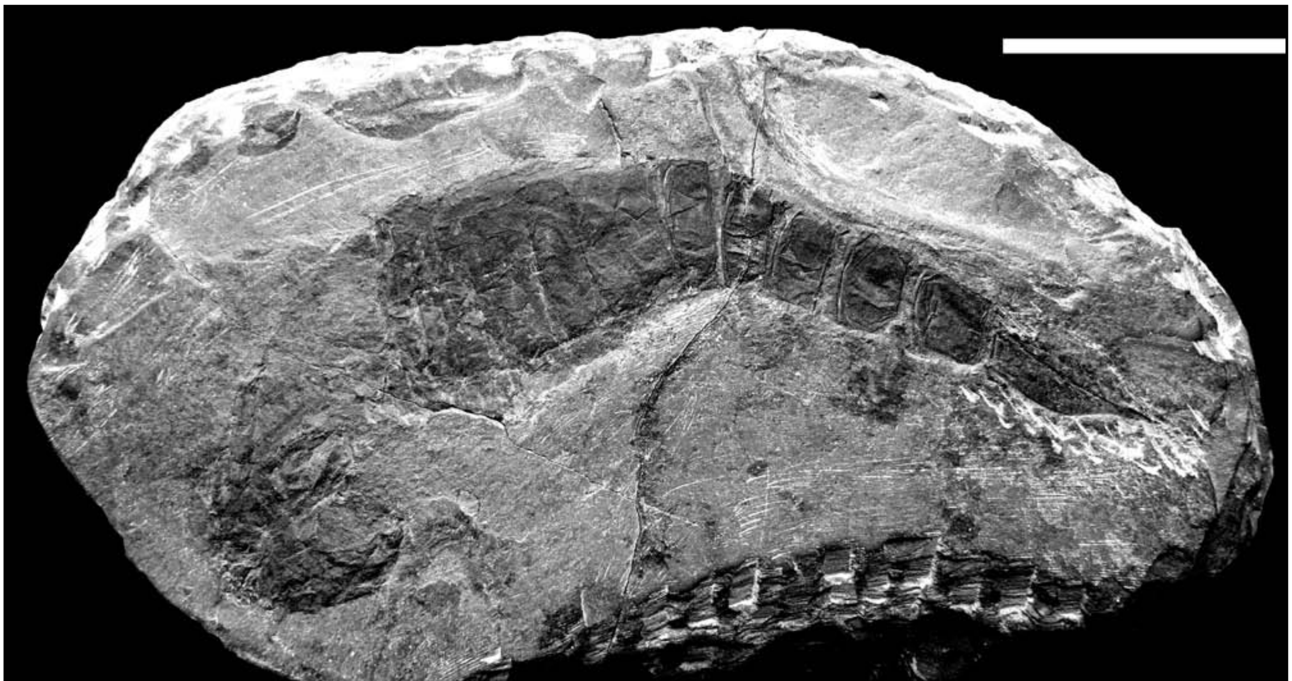

Figure 16. DONMG:ZG2307. **Slimonia acuminata***. Specimen consisting of articulated prosomal and isolated prosomal region. Scale bar = 10 cm.*

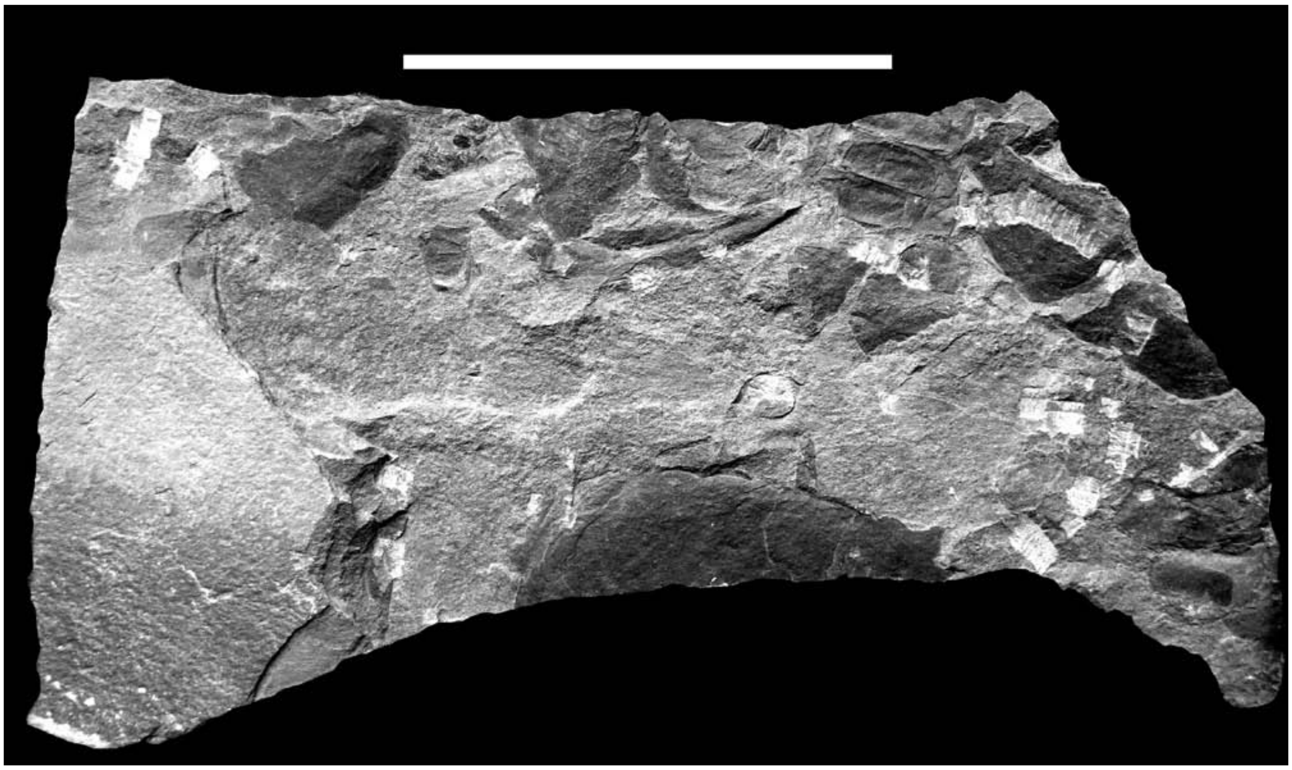

Figure 17. DONMG:ZG2308.* Slimonia acuminata*. Cuticle fragments including* Slimonia *telson.
Scale bar = 10 cm.

DONMG:ZG2307 - Figure 16. Nearly complete specimen consisting of opisthosoma, telson, and disarticulated prosoma. Opisthosoma consists of 12 segments articulated with the telson, which is foliate. The prosoma is disarticulated from the rest of the body, with the anterior appendages relatively well preserved. These are of the *Slimonia*-type, with spines distally fringing the podomere boundaries. The specimen has a length of 11.8 cm measured with the curvature and without the poorly preserved prosoma section. Its maximum width is 2.7 cm. Both the swimming legs are apparent and measure respectively, 3.5 cm and 3.5 cm in length with widths of 0.3 cm and 0.5 cm.

DONMG:ZG2308 - Figure 17. Conglomeration of disarticulated fragments, yielding a small array of eurypterid tergites three of which are articulated at the lowest point of the matrix. Towards the centre of the specimen a foliate telson may be seen. There are also a further two possible carapaces and six tergites visible.

DONMG:ZG2309 - Figure 18. Large, complete telson surrounded by cuticular fragments. The telson is foliate, with a serrated margin comparable to DONMG:ZG2304. The length of the telson from the very distal tip end measures 12 cm with a width of 6.6 cm.

DONMG:ZG2310 - Figure 19. A pair of *Slimonia*-type appendages each consisting of 8 podomeres, including the coxa. Gnathobases are present on the coxae with spines fringing the podomeres distally. The specimen was at some point in several sections and has been reassembled. A pitted ornamentation runs across some areas of the specimen where the integument has been preserved. Its maximum length is 15.8 cm.

DONMG:ZG2321 - Figure 20. Isolated type A genital operculum. The deltoid plates, lateral flange and central groove are preserved. Spatulae, which are normally considered absent, are preserved either side of the genital appendage and their presence suggests that Caster and Kjellesvig-Waering (1956) were correct in suggesting these are present on all eurypterids but normally folded dorsally. The total length measures 15.2 cm with a maximum width of 3.3 cm. The appendage measures 2.3 cm in length and 0.4 cm in width.

DONMG:ZG2325 - Figure 21. Very large, elongated carapace. Carapace long rectangular in shape with cardiac lobe preserved at its posterior. Lateral eyes oval and positioned marginally. Three rows of pustules are present on the anterior marginal rim, similar to DONMG:ZG2304. The length of the carapace is 16.9 cm with a maximum width of 9 cm.

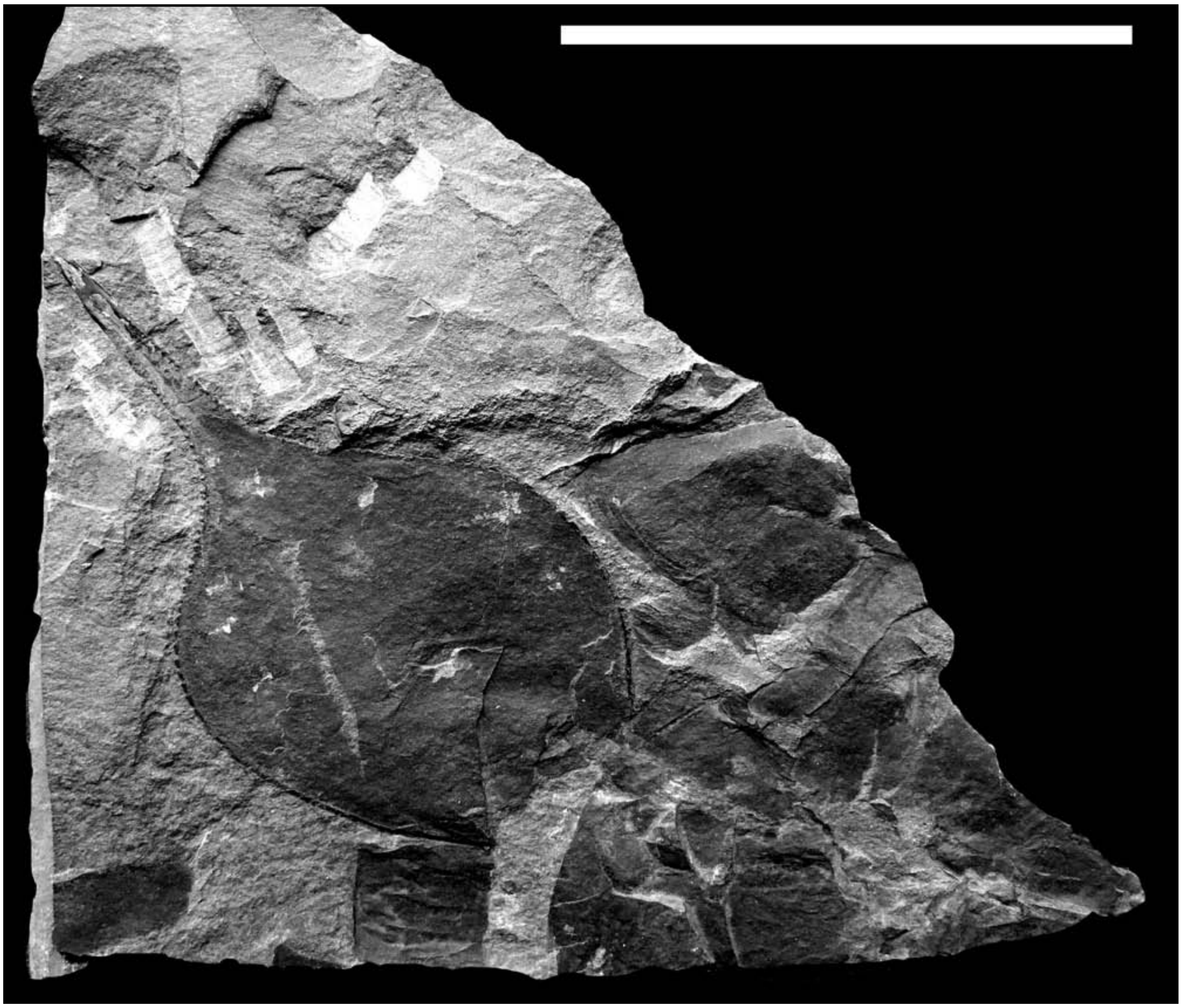

Figure 18. DONMG:ZG2309. **Slimonia acuminata***. Large telson. Scale bar = 10 cm.*

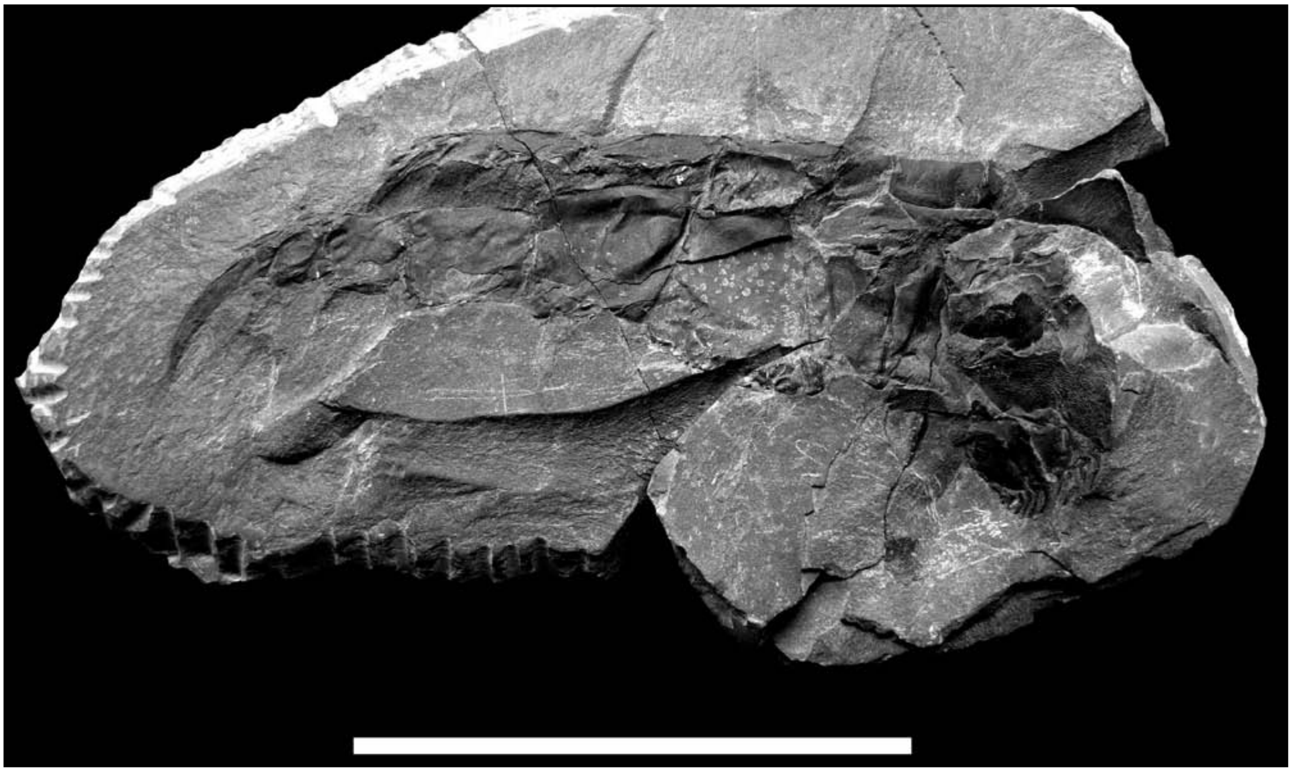

Figure 19. DONMG:ZG2310. **Slimonia acuminata***. Isolated anterior prosomal appendages. Scale bar = 10 cm.*

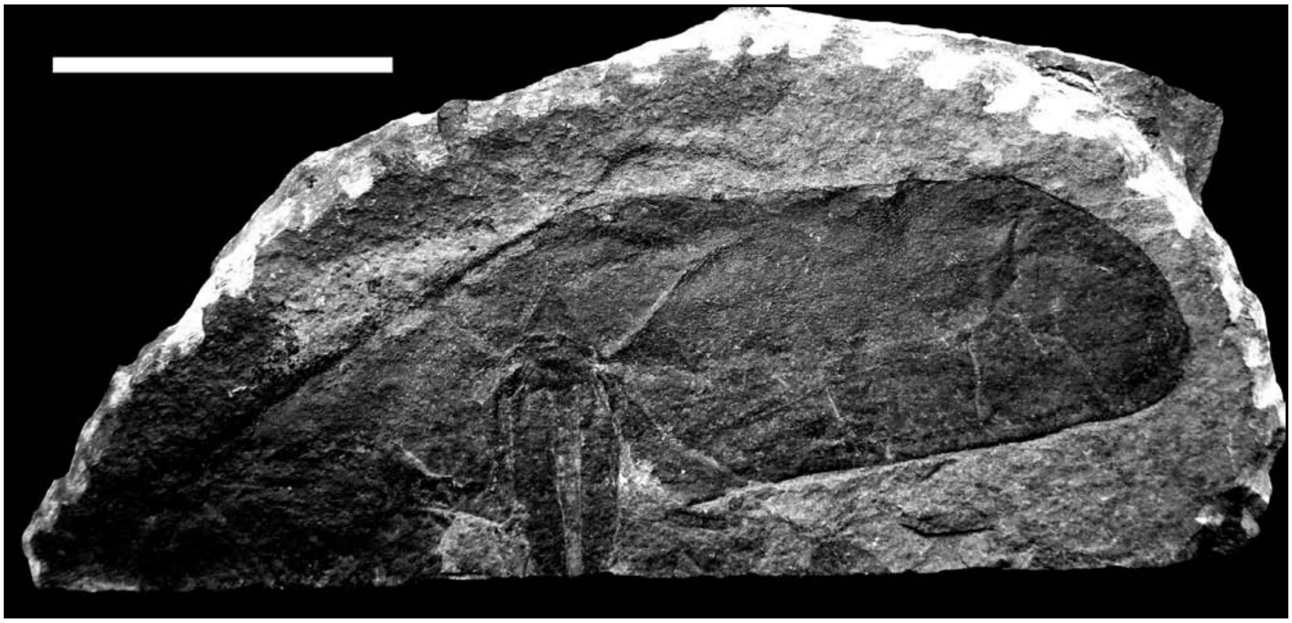

Figure 20. DONMG:ZG2321. **Slimonia acuminata.** *Isolated genital operculum. Scale bar = 10 cm.*

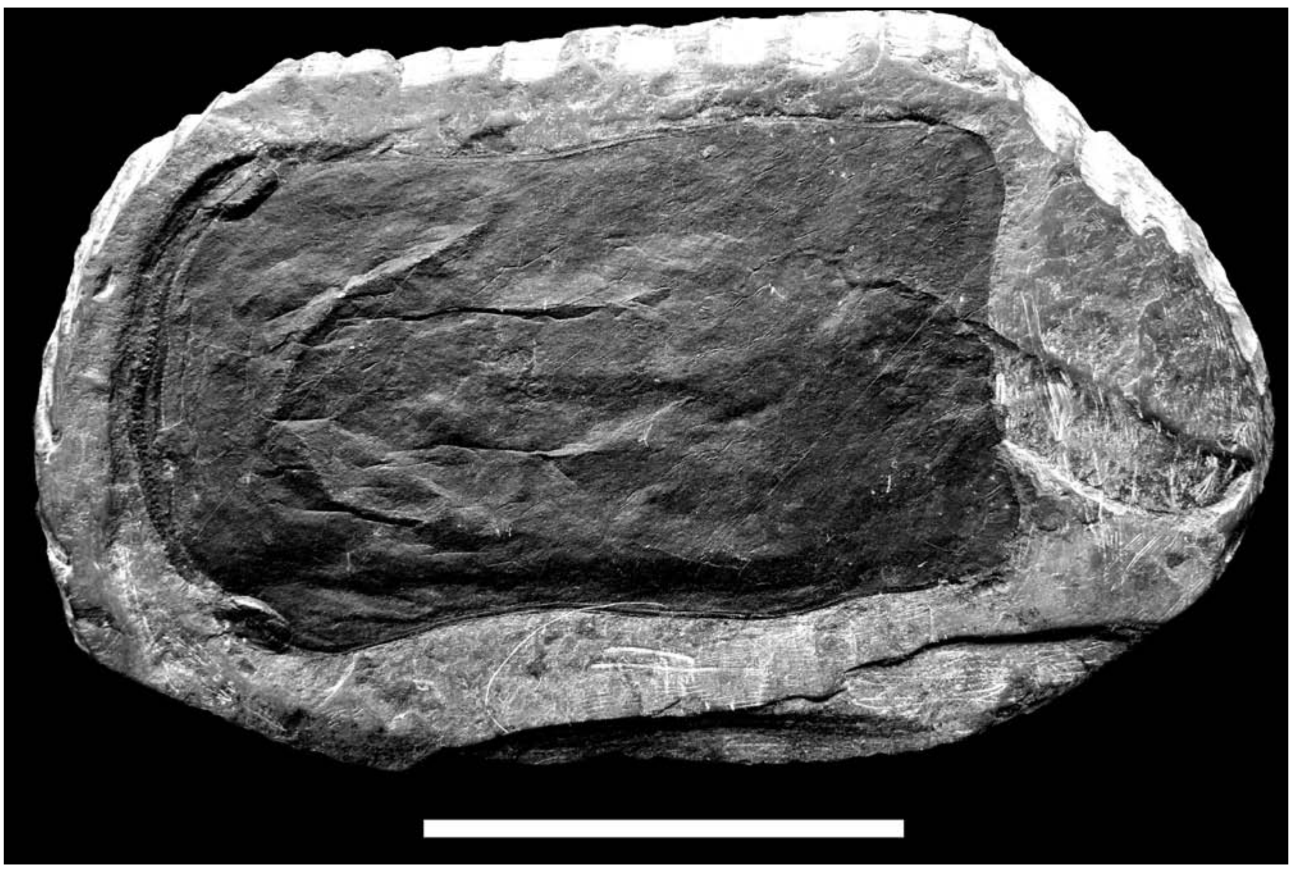

Figure 21. DONMG:ZG2325. **Slimonia acuminata.** *Carapace showing the ornamentation of the marginal rim. Scale bar = 10 cm.*

DONMG:ZG2326 - Figure 22. A second elongate carapace. Detail not well preserved, but similar to DONMG:ZG2325 and DONMG:ZG2327. Lateral eyes oval, anterior marginal rim broad. Muscle scars are located centrally at posterior third of carapace. The unusual pustular ornament across the front of DONMG:ZG2325 is also seen here. The length of the specimen measures 15.1 cm with a maximum width of 9 cm.

DONMG:ZG2327 - Figure 23. Poorly preserved long rectangular carapace, similar to DONMG:ZG2326. Both oval lateral eyes present, with broad anterior marginal rim preserving 2-3 rows of large pustules. The specimen measures 12.1 cm in length and 10 cm in width.

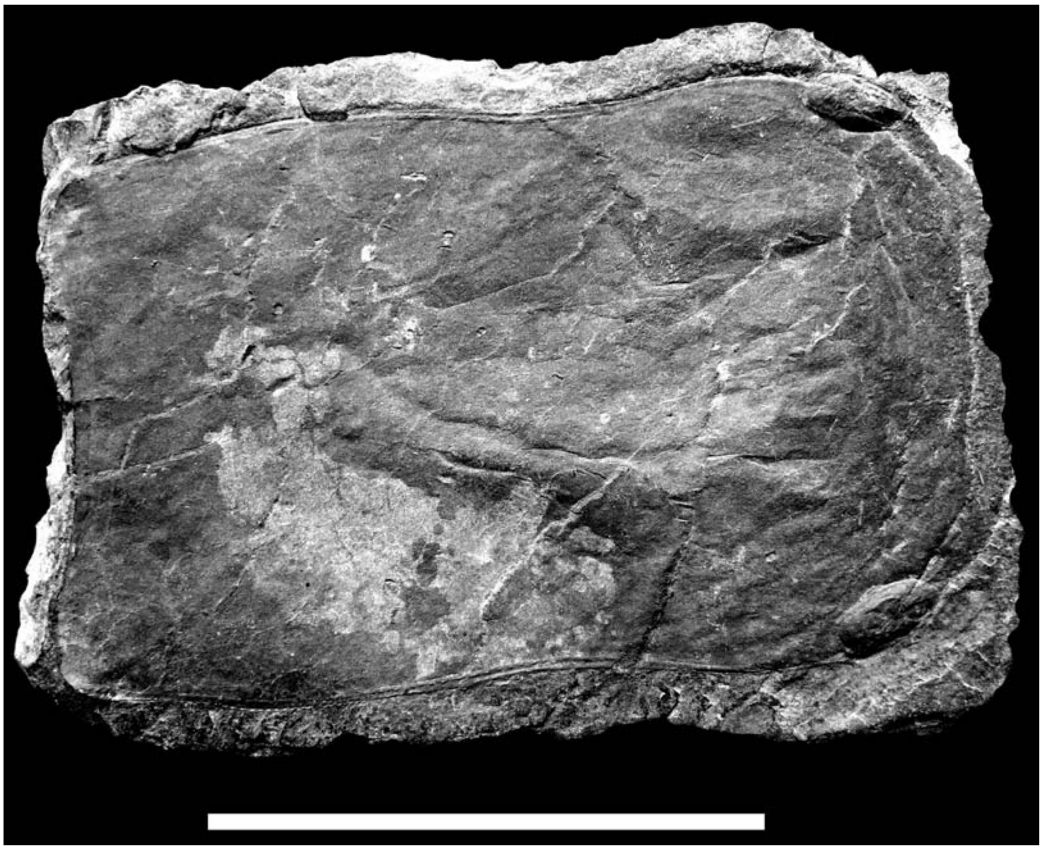

Figure 22. DONMG:ZG2326. **Slimonia acuminata.** *Isolated carapace. Scale bar = 10 cm.*

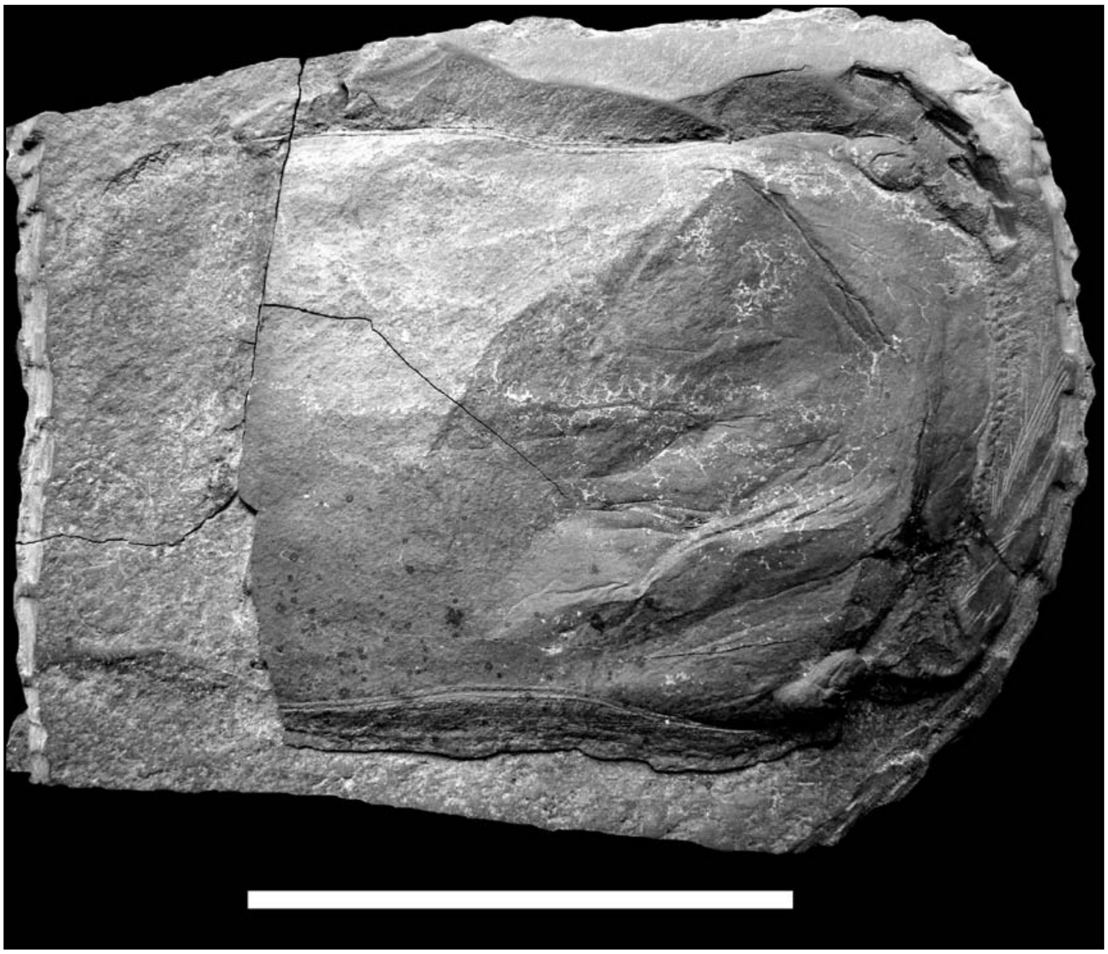

Figure 23. DONMG:ZG2327. **Slimonia acuminata.** *Isolated carapace. Scale bar = 10 cm*

Remarks

Like *E. bilobus*, *Slimonia acuminata* is in need of a modern re-description. Towards this, two structures of note have been recognised in the Doncaster specimens. The first, the rows of pustules on the anterior marginal rim, is a characteristic that appears unique to the genus (if not the species). Pustules can form the attachment points for setae, and a somewhat similar row of pustules was described fringing the marginal rim of *Drepanopterus abonensis*, which was described as an early sweep-feeder that may have used its marginal rim to shovel in the substrate in the hunt for prey (Lamsdell *et al.* 2009). Appendage pair II of *S. acuminata* is more gracile than the others and has been suggested to have had a tactile sensory function similar to the pedipalps of modern spiders; if the pustules of *Slimonia* did possess sensory setae they might have functioned with the pedipalps as a tactile sensory battery to aid in the identification and location of prey.

The presence of spatulae on DONMG:ZG2321 is also of interest as these structures have not been recognised on *Slimonia* previously despite the in-depth study of the genital appendage by Waterston (1960). This supports the notion of Caster and Kjellesvig-Waering (1964) that all eurypterids possess genital spatulae but that in most species the spatulae are small and folded dorsally above the operculum so as to be undetectable, with only a few species having hypertrophied spatulae that are regularly identified in the fossil record.

Conclusions

The rediscovery of the eurypterid specimens held in the palaeontology collection at Doncaster Museum and Art Gallery has enabled this preliminary discussion of each specimen and its relevant importance. The original donor, date of donation, locality information and specimen history were lost, however evaluation of the available information has allowed the majority of this data to be reconstructed. The eurypterids (and phyllocarids) were part of a large collection obtained by Dr Hunter-Selkirk in the mid to late 1800s, of which the majority were donated to the Dick Institute, most of which are still held there. The Dick Institute donated the eurypterid specimens discussed herein to Doncaster Museum in the 1960s. Although no written evidence was obtained, it was probably the year 1964, when the Doncaster Museum and Art Gallery first opened. The provenance of the eurypterids was previously dubious, however through comparison with collections at the Dick Institute it is clear the specimens primarily derived from the famous Logan Water within the Lesmahagow inlier of Lanarkshire. This rediscovery is important to the Doncaster Museum and Art Gallery with respect to documenting the strengths of the collections and identifying specimens, and specifically for eurypterid researchers as the majority of the specimens are derived from an area that is mostly protected and where modern collecting is deemed nearly impossible. Most specimens are perfectly preserved; the completeness and excellent preservation of most of the eurypterids should make further research possible. On a final note, this study has allowed each specimen to be accessioned into Doncaster Museum's collection using the collection management system MODES.

Acknowledgements

We wish to thank Benjamin Hyde for assisting with images, Jason Sherburn for help with images and cataloguing of specimens and Dr Neil Clark, Dr Colin Howes, Jason Sutcliffe and Dr Simon Braddy for numerous conversations, information and advice to help progress this paper, thanks also to Byron Blessed for help confirming the identity of the first two eurypterid specimens rediscovered in 2008. JCL thanks Amanda Falk for discussion and reviewing an early draft of the manuscript. Many thanks to Dr Jason Dunlop, who provided extremely useful comments during the review process. A special thanks to the Western Interior Paleontological Society (WIPS) for awarding a Karl Hirsch Memorial Grant to Dean Lomax, and thus providing funding for research and documentation of the eurypterid collection. A final thanks to Peter Robinson and Doncaster Museum and Art Gallery for allowing the study of the eurypterid collection.

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NATURE'S INTERACTIVE - CURATING AND DISPLAYING FLEXIBLE SANDSTONE

by Helen C. Kerbey

Kerbey, H.C. 2011. Nature's Interactive - Curating and displaying flexible sandstone. *The Geological Curator* 9 (6): 349 - 352.

Flexible sandstone is an intriguing rock found in many geological collections, yet little is commonly known about its origins. It has been found in many different locations around the world and appears to be formed by metamorphism of quartz rich sandstone resulting in dissolution of quartz at the grain boundaries into highly irregular, yet interlocking shapes. It is an interesting rock to display and, with a few precautions, can be made into an effective interactive display.

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Introduction

Flexible sandstone, often called itacolumite, occurs in only a handful of places in the world yet is found in many geological collections in museums. The earliest references to flexible rock go back to at least Rand (1657), where Nicolas Peiresc discusses the flexibility of some whetstone he had been shown. Flexible sandstone is discussed in numerous early 19th century journals, especially those that contain descriptive reports about society meetings of the style "During the meeting Dr Smith showed us a remarkable specimen of flexible rock...." However, the most informative descriptions are from geologists such as James Hutton (Hutton 1794) and chemists such as Klaproth (1801, pp.409-412) whose work "Analytical Essays towards promoting the Chemical Knowledge of Mineral Substances" contains results not dissimilar to those obtained today.

Itacolumite - flexible or not?

In the early eighteen hundreds a geologist called William Ludwig von Eschwege proposed that a new rock found in Brazil was forming diamonds, and went on to call the rock type 'Itacolumite' after the Itacolumi (now spelled Itacolomi) mountains in Minas Gerais (Eschwege 1822). Unfortunately he applied the name to a very large range of quartzites that included several different variations in lithology, and included both non-flexible and flexible quartzites. The diamond genesis hypothesis caused a flurry of interest with everyone searching for similar rocks around the world. This meant that from 1822 to about 1900 the term 'itacolumite' was used for both flexible and non-flexible quartzites. Once it was determined by more observant geologists such as Orville A. Derby (e.g. Derby 1882, 1906) that 'itacolumite' was a metasedimentary rock and that the diamonds found within it were clastic, the interest was lost and the name began to become synonymous for flexible specimens alone. (See for example Cayeux, 1929, pp. 196-199).

Geology and Localities

Today flexible specimens are known from a handful of areas, each one geologically distinct from the other. Museum specimens tend to be vague in detail, and though three general areas are the most common (Ouro Preto, Brazil; North Carolina, USA; and Kaliana, India) there are different locations, and even different stratgraphies, within these areas where flexible specimens have been found (See Kerbey, 2011). This means that assigning more detailed localities to unlabeled specimens is very difficult.

Most specimens are in collections as cut elongate bars and the degree of flexibility varies. Some bend considerably (Figure 1) while others, especially rough field specimens (Figure 2), only creak slightly when manipulated. The major component in all cases is quartz, though the mineralogy of samples from different areas varies. Some specimens are micaceous, others are not. Some are more metamorphosed and contain kyanite, so the term flexible quartzite may be more technically correct for these, while others have some feldspars and clay minerals in them and are more correctly termed sandstones.

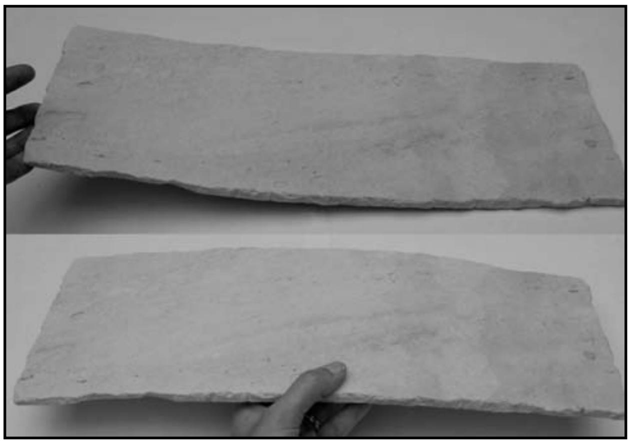

Figure 1. A thin plate of flexible sandstone from Ouro Preto, Brazil.

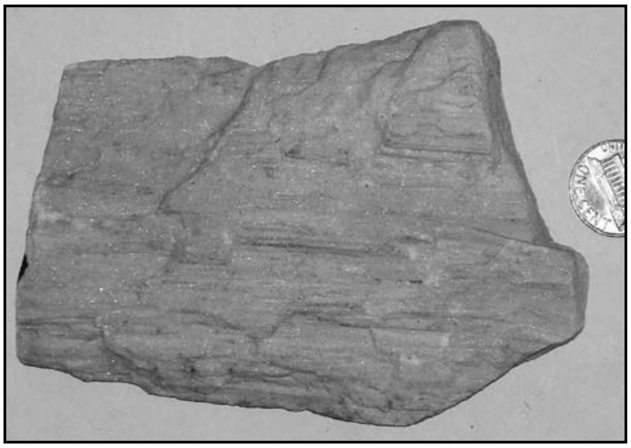

Figure 2. Field specimen from Georgia, USA (Smithsonian Institute No. 12914), with low flexibility.

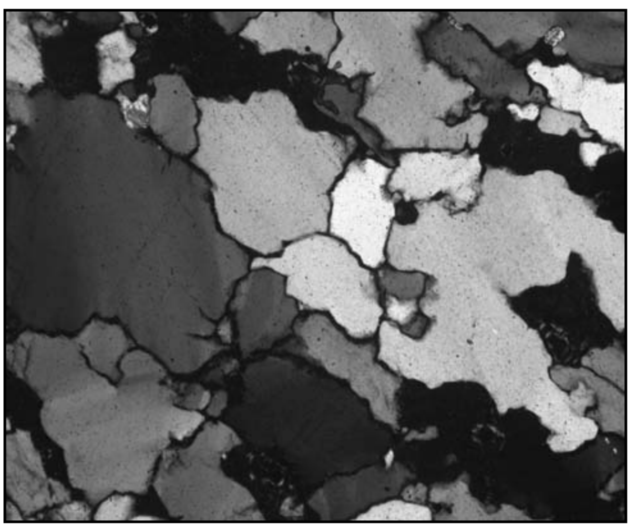

Figure 3. Crossed polars thin section photo showing the interlocking nature of the quartz grains. Field of view 2mm. National Museum Wales specimen GER121 from an unknown location.

When curating flexible specimens the rock type should be identified as near as possible but it would also be useful to record a keyword term such as 'itacolumite' or 'flexible'. Care should be taken with spelling and terminology as there are many variants in spelling such as itacolumyte and itacolumnite, and also in terminology such as elastic quartz and limber grit.

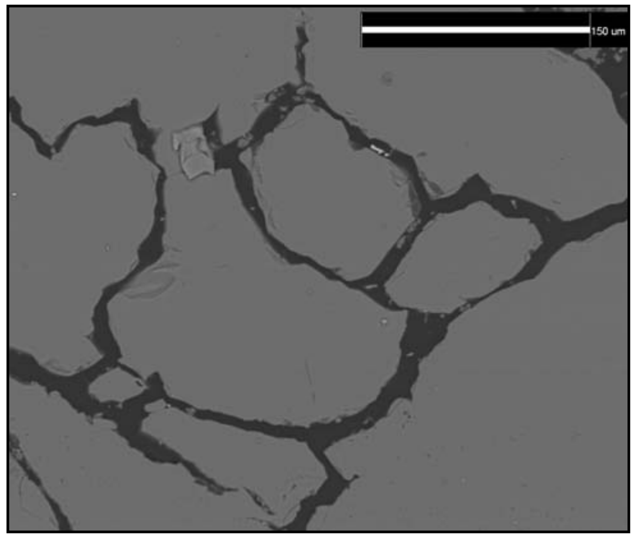

Figure 4. Backscatter image using a scanning electron microscope showing the uniform intergranular gaps between quartz grains at high magnification. The specimen is a polished thin section and the intergranular gaps have been infilled by resin. Scale bar is 150µm. National Museum Wales specimen GER121 from an unknown location.

Whether micaceous or not, in each case the underlying cause of the flexibility is due to a three dimensional network of interdigitated loose quartz grains as shown in Figures 3 and 4. The cause of this structure is not completely known since there is no evidence of any cement having been present, however a recent in situ study in Brazil (Suzuki and Shimizu 2003) found sequences of increasing quartz dissolution leading to increasingly flexible rock suggesting that the main process is dissolution of quartz at the grain boundaries.

Displays

The term 'nature's interactive' comes from North Carolina Museum of Natural Sciences where a specimen of flexible sandstone was first displayed in 1933 with a turning handle (Chris Tacker pers comm.). Itacolumite is not particularly delicate, however many specimens in museum collections are in pieces or contain cracks due to being flexed too vigorously. Since it is fairly difficult to purchase new specimens they do require some supervision if they are to be used for handling.

Figure 5 shows an old display from the National Museum Wales. It would appear that the specimen was displayed unprotected and it is lucky that it has not been broken. A label on the bottom of the contraption states 'press lightly'

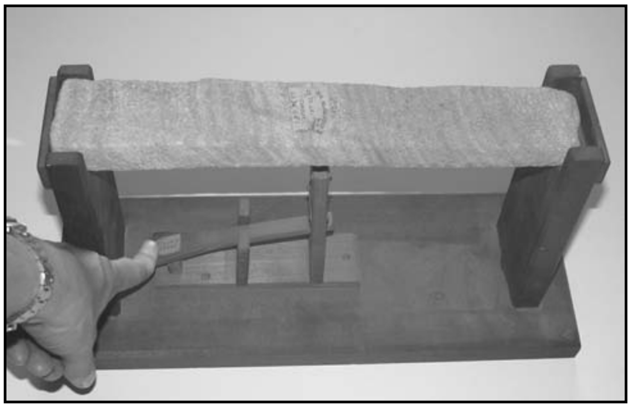

Figure 5. Flexible sandstone from South Carolina on a wooden display stand. The difference between bedding and direction of flexibility is very clearly demonstrated here. (National Museum Wales specimen NMW23.71G.R.1).

Figure 6 shows a simple but effective display. The specimen is protected but still shows its properties. Additional interpretation such as a video showing someone bending it could also be added.

Figure 6. A simple but effective display of flexible sandstone labelled as from Delhi, India. A more precise location is likely to be from the Kaliana Quarries. (Photo: Andrew Haycock).

Figure 7 allows the specimen to be bent by turning a handle that pulls a spring. This simple design allows the user to be quite interactive but by using the spring, not very much energy is transferred to the specimen and in this case it didn't actually move very much at all.

Figure 8 allows the specimen to be safely touched. It shows a thin flexible specimen loosely contained between two perspex plates. A hole in one plate allows you to touch the specimen and bend it slightly. This is more suited to thin itacolumites and the specimen could become broken so there is some risk. The specimen has become discoloured where it has been frequently touched.

Figure 9 requires the most working parts. By pressing a button a small tractor moves forward, places its bucket under the specimen and then lifts it up and

Figure 7. Flexible sandstone at Hanging Rock National Park, North Carolina, USA. Here specimens are found in the Sauratown Mountain Quartzite of the Kings Mountain Group, dated at c.*540Ma.*

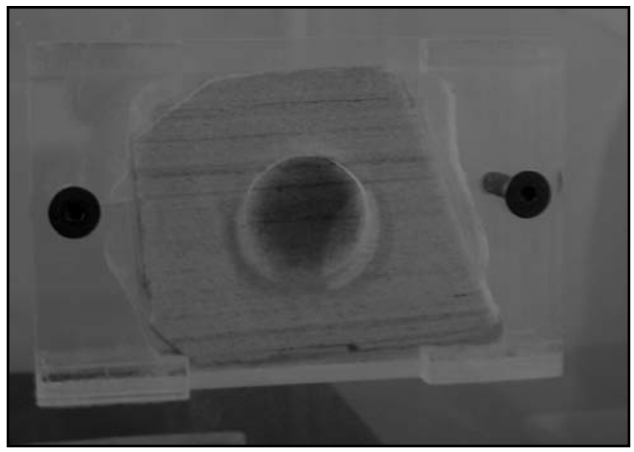

Figure 8. Touchable specimen of flexible sandstone in the Colburn Earth Science Museum in Ashville, North Carolina, USA. Probably the same source as Figure 6 but could be from the nearby Lower Cambrian Erwin Quartzite Formation.

Figure 9. Specimen of flexible sandstone in the Colburn Earth Science Museum in Ashville, North Carolina, USA. Probably the same source as Figure 6 but could be from the nearby Lower Cambrian Erwin Quartzite Formation.

down several times. The long term implications of flexing the specimen repeatedly are probably that the quartz grains get broken and become more rounded so the specimen may start to crack but by carefully controlling the speed and height of the movement the risks should be minimised.

Acknowledgments

I am grateful to Chris Tacker from North Carolina Museum of Natural Sciences for telling me about the term 'Nature's Interactive' and for supplying information about the specimens there.

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'FANTASTIC FOSSILS' A SPECIAL EXHIBITION SHOWCASING KENT'S GEOLOGICAL HERITAGE HERNE BAY MUSEUM, 12TH MARCH-5TH MAY 2011

by Philip Hadland

Hadland, P., 2011. 'Fantastic Fossils' a special exhibition showcasing Kent's Geological Heritage. Herne Bay Museum, 12th March-5th May 2011. *The Geological Curator* 9 (6): 353 - 356.

In the spring of 2011 Herne Bay Museum was the setting for a special exhibition based around the subject of fossils. The aim of the exhibition was to break down the complex world of fossils into a regimented and concise form that the general public could easily understand and using fossils found in the local area in this context. The focus on local fossils, the involvement of a local artist and participation of local groups provided for a satisfying exhibition on many levels.

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Introduction

Geological collections are not often the main subject of special exhibitions in museums. The focus is usually archaeology, art or social history and this is reflected in the ever depleting numbers of natural science curators in museum. Sadly the subject of geology seems to have been neglected in recent years, even in some larger museums with nationally significant collections where curator posts have been frozen as funding cuts have hit home. However it is important that the potential of geological collections, even in smaller museums is fully realised. This helps ensure that they are cared for properly, are available for research and perhaps most importantly are kept in the public domain and used to inspire interest in the subject. Traditionally local and district museums with palaeontological collections maintain small permanent displays of local fossils but often these only show a small fraction of the variety of fossils in their collections. This is the case in Canterbury's District Museums where the displays contain only fossils found within the local area. Anyone could be forgiven for thinking that the museum has very little else behind the scenes. In fact a number of fantastic fossil collections are held in storage begging to be put on display. Special exhibitions are perhaps the best way of opening up these collections to the public.

There are numerous reasons for the lack of geology focussed temporary exhibitions in museums, not least the availability of temporary exhibition galleries. Another reason for not having special geology exhibitions could be, why bother? We already have a permanent display on local geology and fossils. However there are ways in which unnecessary duplication can be avoided to create new and vibrant temporary exhibitions on the subject and of course by utilising collections that are usually in storage, justifies their presence. Collections that are normally in store can also be the source of new display possibilities. Special exhibitions always follow certain themes, be it colour, places, or specific people. The same can be done with any type of collection, including geological ones where themes could be based around locations, historic collectors, time periods or taxonomic groups for example.

Other reasons could be the financial cost, the amount of work required to research the content and formulate effective displays, or a lack of specific staff expertise in the subject. At the museums we minimise labour costs by making use of a team of dedicated volunteers to help construct the exhibitions, meaning the curators can focus more on exhibition content and day to day duties. Without these volunteers our ambitious exhibitions programmes would be impossible to run. Costs and preparation time are also kept down by tailoring the exhibition content to various simple pop-up display cases that the museum has from previous exhibitions.

The museums service is well equipped in terms of expertise with the author having a background in geology and palaeontology and has also built working relationships with a number of local geology based interest groups meaning an extensive pool of expertise in the local geology is available. Canterbury City Council Museums Service also already runs an annual Fossil Roadshow for one day with a new theme every year in partnership with these groups. Themes have included the Ice Age, Extinction, Prehistoric Monsters and Global warming. The event usually attracts in excess of 1000 visitors and is the most popular event of the year so there is certainly high public interest in the subject. With this in mind in Autumn 2010 the decision was made to have a fossil exhibition at Herne Bay Museum (one of the 5 museums run by the City Council).

Fantastic Fossils

Herne Bay is a Mecca for collectors of fossil sharks teeth from the Palaeocene rocks exposed along the coast nearby. As this was the first exhibition dedicated to fossils we had undertaken, so somewhat experimental, it was decided that the exhibition should be about fossils in general but focussing on fossils from Kent. We chose the title *Fantastic Fossils* very early on. In addition to the fossil displays, fossil inspired ceramics (Figure 2a, 7) by local artist Laura Hollis for sale to the public and drawings of some of the fossils by members of the Herne Bay Parasol Art Group (a group for adults with learning disabilities run by the Herne Bay Umbrella Centre) were put on display (Figure 6). This was arranged by Manda Gifford, who as Coastal Museums Outreach Officer programmes exhibitions at Herne Bay Museum working in partnership with a wide variety of local interest groups and artists. The contributions of these artists and groups is always an important part of the exhibition programme run by the service which as well as providing useful content also helps drive local interest and visitor numbers to the exhibitions.

The layout of the main exhibition took the form of a series of questions in a clockwise fashion which set out to explain the world of fossils.

Question 1-What is a fossil?

After defining what a fossil is as 'Fossils are the remains of plants or animals from long ago preserved in rock' the display explained briefly how fossils form. Various fossils such as internal casts of bivalves and carbonised ferns were put on display to show examples of different modes of preservation. In addition, fossilised shark teeth of varying colour were used to explain that a fossil's colour is governed by the minerals contained in the rocks in which they are preserved (Figure 1).

Figure 1. Shark teeth of various colours used to illustrate that the colour of a fossil is influenced by the various minerals in the rocks in which they are preserved.

Question 2-How old are fossils?

The idea behind this display was to show local fossils in the context of the regional geology and their respective time periods (Figure 2a and 2b). The display had to fit behind a Perspex screen in an alcove so space was limited. It took the form of a Generalised Vertical Section (GVS) through the geology of Kent. For the space available, relative thicknesses of the respective layers were not used however given more time an element of this could have been included as well as visual interpretations of unconformities. The colour of each layer was based on a modified geological map of Kent displayed alongside. Each layer had a caption describing the palaeo-environmental setting in which the rocks were deposited with fossils from each displayed on small perspex shelves. This display became the main focal point of the exhibition. The bespoke shelving cost £65 from the Canterbury firm Gordon Engraving. The printing and design work was all completed in house.

One may be surprised to hear that the oldest fossils regularly come across in Kent are Carboniferous fossils found in spoil tips from the Kent coal fields. Sadly all of the coal mines had closed by the late 1980s but we are left with some excellent plant specimens in the museum collection so these formed the roots of the display. The captions for each fossil were placed either side of the display so they did not get in the way and these were numbered to correspond to numbers placed next to the fossils.

Another small display included a rare narrow-nosed rhino jaw and straight-tusked elephant femur lent to us by Chris Wren, a local collector of Pleistocene fossils and we called this *On Safari in Herne Bay* in respect of the warm conditions and similarity of the animals from the time to that seen on a modern day African safari. To supplement this and show the difference between the straight tusked elephants and mammoths, a mammoth tooth and a fragment of a very large mammoth tusk were exhibited along side an artist's representation of a juvenile woolly mammoth (Figure 3).

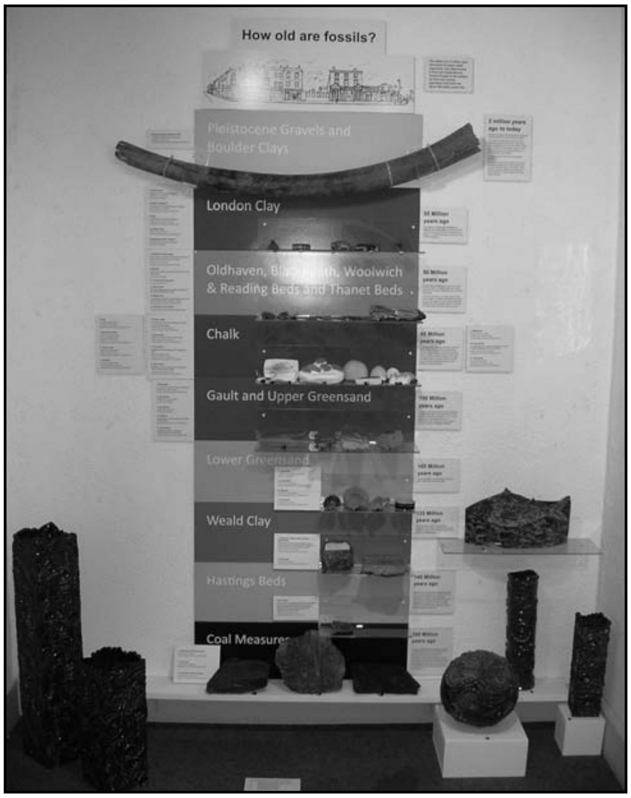

Figure 2a. Display of local fossils. Ceramics by Laura Hollis are displayed on either side.

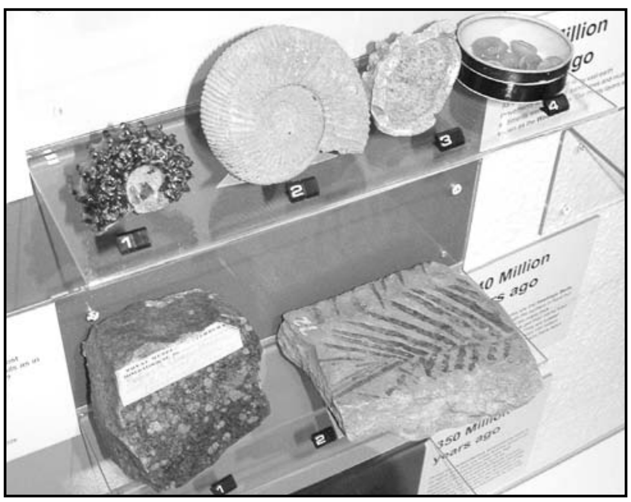

Figure 2b-Close up of display of local fossils with numbers for reference to captions.

Question 3-Why are fossils important?

This display highlighted the fact that microfossils were used to guide the route of the Channel Tunnel through a specific rock layer called the chalk marl or grey chalk. In addition, a small display of piece of coal and bottle of oil explained that 'without fossils we would not have fossil fuels' to highlight the importance of fossils in our everyday lives.

Question 4-How do you collect fossils responsibly?

Whilst trying not to discourage the collection of fossils the subject of collecting fossils responsibly is a very important one, not only to protect potentially important fossil specimens from being lost to science but also for the welfare of the collector. A brief outline of the fossil collecting code was supplemented by a small display showing a simple collecting kit (Figure 4), safety advice and information about good local places to look for fossils, which Kent has in abundance.

Figure 3. During set up. A simple outline sketch of a juvenile woolly mammoth provided an additional focal point and a sense of scale.

Figure 4. A fossil collector's kit.

Other small displays in the exhibition included *Living fossils* (Figure 5) with a display of nautili from various time periods and *Local Heroes*. *Local Heroes* focussed on two local collectors from the 19th Century namely Francis Crow, a collector of fossil plants from the London Clay, and Colonel Cox who polished hundreds of flint pebbles, revealing the beautiful structure of fossil sponges inside. With more research themes such as *Local Heroes* or particular historical collectors for which extensive histories are known could form the entire basis of a future exhibition.

In addition to the fixed displays, trays containing real fossils were available to handle and other hands on activities such as design a dinosaur, create a prehis-

Figure 5. A small display focussing on the* Nautilus*-a living fossil with examples from the Inferior oolite (front left), the Lower Gault (front right), the Chalk (back right), the London Clay (back left) and a modern example (middle).

Figure 6. Drawings inspired by fossils by members of the Herne Bay Parasol Group.

toric landscape and looking at microfossils under the microscope added important hands-on elements to the exhibition. A series of drop in events were also arranged at the museum. For one of the events we invited some local collectors to bring in some of their finds to show to the public which included a selection of Chris Millbank's London Clay Fossils and Chris Wren's Pleistocene fossils and stone tools from Herne Bay.

Summary

From the visitor feedback we believe that the exhibition has been a success and well worth the effort. Amongst the positive feedback we have had one comment which stands out: '*Love the mix of art and science'*. You could say that any fossil display with a palaeo-reconstruction or children's book about dinosaurs is a mixture of art and science. In the same way many great artists such as Leonardo DaVinci honed their artistic trade through the study of sciences like anatomy. Most early textbooks also relied upon highly detailed drawings of fossils. So perhaps this is reconciliation between art and science in a museum. *Fantastic Fossils* is also a really good example of partnership working from initial ideas to finished exhibition and events programme between a geology specialist and the museum's Learning and Exhibitions team. At the very least it will hopefully encourage more geology related special exhibitions in other museums.

Figure 7. Fossil ceramics by Laura Hollis alongside the real thing!

Acknowledgments

I would like to thank to the following partners for their invaluable contributions in creating the exhibition: The museum team especially Manda Gifford and Martin Crowther. The various partners: Canterbury City Council Design, Text Production and Print services, Chris Millbank, Chris Wren, David Rayner of Medway Fossil and Mineral Society, Dover Museum, Herne Bay Historical Records Society, Laura Hollis, Our team of volunteers, especially Steve and Julia Keeler, The Parasol Group of the Herne Bay Umbrella Centre

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Laura Hollis Ceramics and Silk Painting www.laurahollis.com

Herne Bay Umbrella Centre http://hernebayumbrella.btck.co.uk/Programme

Canterbury City Council Museums Service http://www.canterbury.co.uk/Canterbury-Museums.aspx

WHAT'S IN A (WRONG) NAME? THOUGHTS ON THE TRUE UTILITY OF ELECTRONIC MUSEUM CATALOGUES

by Stephen K. Donovan and Matthew Riley

Donovan, S.K. and Riley, M. 2011. What's in a (wrong) name? Thoughts on the true utility of electronic museum catalogues. *The Geological Curator* 9 (6): 357 - 362.

Electronic collections catalogues need to be accurate even if they are not correct. A specimen in the collections of the Sedgwick Museum, Cambridge, from the Llandovery (Telychian) of the May Hill Inlier of the Welsh Borders, is identified therein as *Periechocrinus moniliformis* (Miller). This species was based on inadequate material and is unidentifiable; it would provide nothing but confusion if used uncritically in the compilation of a database. But this indication of a Llandovery crinoid promises much to the informed observer. British Llandovery crinoids remain rare. This specimen is just a fragment of column, derived from a cladid or camerate, but it was infested by an epizoozoan, a bryozoan, only the second such association recognised in the Telychian of the British Isles. The specimen also asks a taphonomic question: why is the bryozoan preserved as a mould, yet the crinoid is still calcitic?

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Introduction

From the point of view of a systematist, the proliferation of digital museum catalogues is an important development that has provided a new research tool (almost) for free. Before visiting a museum, which may be costly and could involve international travel, a researcher can either peruse the catalogue on-line or request an indication of relevant holdings via an e-mail. Again, cost effectiveness is improved, but it may involve a certain amount of faith for the researcher to accept the accuracy of the catalogue of some remote museum. Even if an image or images are available, only by visiting the collections or accepting a loan of material can the researcher truly bring their own expertise to bear on the specimen(s) of interest. It is the trust that researchers can place in digital catalogues that we wish to explore, based on our recent experience amongst the Silurian crinoids of the A. G. Brighton Building of the Sedgwick Museum of Earth Sciences, University of Cambridge.

The Sedgwick Museum collections database

In the late 1960s, J. L. Cutbill of the Department of Geology at the University of Cambridge began a study on how computers could be used to catalogue and manage museum collections. With the Sedgwick Museum's collections as his inspiration, he and his team developed a then state-of-the-art GOS computer package that was later shared with the wider museum community via the Museum Documentation Association (MDA), itself a product of the Cambridge project (Price 1984). Many of the standards recommended by the MDA for cataloguing collections followed the work of A. G. Brighton, the Curator of the Sedgwick Museum, whose huge contribution to documenting the vast Sedgwick collections is still widely recognised.

It is interesting to note that many of Cutbill's initial observations made during the planning stages of his digitisation project some 40 years ago are still relevant to museums today:

> "Many geological problems involve collecting large amounts of data, and storage, retrieval, communication and display of these data. Such operations are essential, but usually tedious and rather costly. It is rare to find a geologist who feels he has adequate resources for this side of his work."

> "The most urgent problem facing curators is to find some means of cataloguing this vast backlog of material so that it will become available for reference and research and to achieve this aim without any dramatic increase in resources." (Cutbill, 1967).

The Sedgwick's current Content Management System (database), *Mobydoc's snbase*, is capable of recording every type of data imaginable relating to the collections, from identifications, provenance and geological dating, to loans, conservation treatments and bibliographic references. Approximately 20 % of the Sedgwick Museum's 1.5 million rocks, fossils, minerals, archaeological artefacts, zoological and botanical specimens are currently catalogued on the database.

The recent addition of archive program GAPI to the Mobydoc hub will enable object data and information from the Museum's extensive historical archive to be linked together, offering even more to any researcher hungry to dive deeper into the history of the Museum's collections or Department of Earth Sciences research. In the next few years the Sedgwick Museum will be further improving access to its collections via the web by publishing online a catalogue of the 10,000+ type specimens that it holds. Such was the importance of the *Catalogue of Type Fossil in the Woodwardian Museum*, Cambridge by Henry Wood (1891) that a revised catalogue, accessible to all at the click of a mouse (or poke of a touch-screen), is a current priority.

The Sedgwick Museum stores

The Sedgwick Museum has two centres in which it stores its fossil collections. The main museum building in Downing Street houses mainly the older collections, arranged first stratigraphically, then by locality, then taxonomically. Most of the specimens of Wenlock echinoderms (mainly crinoids and rhombiferans) from the Much Wenlock Limestone Formation (Homerian) of the Dudley area are kept here in close association. These are typical Dudley material, well preserved, correctly identified and forming part of one of the most diverse echinoderm faunas known, globally, from the Lower Palaeozoic (Lewis *et al*. 2007; Donovan *et al*. 2008). The crinoids, in particular, are diverse, representing species that are well documented and have been a focus of research since Miller (1821) and Phillips (1839), through others such as Bather (various papers), Ramsbottom (1953), Widdison (2001a) and Donovan *et al*. (2008, 2009, 2010 & in press).

The A.G. Brighton Building, coincidentally named after an echinoderm worker (Price 1989), was built in 1991 and houses what is essentially the collections overflow from the main Museum (over half of the palaeontology collection), as well as the Museum's Conservation Unit. A third store in the Atlas Building houses the petrology collections.

The catalogue records that a smaller collection of significant crinoid specimens from elsewhere in the Silurian of the UK can be found at the Brighton Building, such as the oldest British Llandovery crinoids from Haverfordwest (Ramsbottom 1953; Donovan 1993) and Ludlow crinoids of the Lake District (Ramsbottom 1958; Donovan *et al*. in press). But these specimens are dispersed throughout a far larger collection, as are other crinoids that have, as of yet, to be published. It is the latter that represent an exciting unknown to the echinoderm researcher - what treasures are hiding amongst them? The only guide to where relevant material may be hiding is the catalogue (ignoring, for the present, the portion of the collections that are completely uncatalogued and no doubt contains a whole host of tasty morsels for future research). We examine the catalogue entry of one such specimen, an undoubted treasure, but the extreme contrast between the crinoid and its catalogue entry is worthy of note, and is perhaps of wider significance.

Locality and horizon

The specimen label of Sedgwick Museum (CAMSM) A60105 states "*Periechocrinus moniliformis* (Miller). Base of May Hill; Up. Llandovery. Dingle Quarry, between Worcester Beacon & Sugar Loaf, Malverns. T McKenny Hughes Coll." Although we have not been able to find reference to Dingle Quarry *per se*, the Upper Llandovery (Telychian) of the May Hill inlier, on the Herefordshire/Gloucestershire border, is well documented (see, for example, Ziegler *et al*. 1968; Lawson *et al*. 1982) and spans most of the Telychian (Cocks *et al*. 1992, fig. 3). The Huntley Hill Beds are unconformable on the Precambrian and "... have yielded few fossils" (Lawson 1955, p. 87); these form the summit of May Hill. The overlying (but topographically lower) Yartleton Beds ... contain many highly fossiliferous bands" (Lawson 1955, p. 88) and underlie the crinoid-rich *Petalocrinus* Limestone (Pocock 1930; Fearnhead and Donovan 2007). From the available information, we suggest that CAMSM A60105 is, most probably, from the Yartleton Beds (mid-*griestoniensis* to *crenulata* Biozones).

On the same rock chip a second, mouldic fossil, a tabulate coral, is named *Favosites* cf. *aspera* d'Orbigny (CAMSM A60106), with a gracile morphology obviously different from that of the bryozoan (see below). The sandstone contains other invertebrates preserved as both moulds and calcite.

Description

The specimen (Fig. 1) is preserved in a fine-grained sandstone containing abundant shells and natural moulds. It consists of a short crinoid pluricolumnal, preserved as pale grey calcite, surrounded by an external mould of a colonial organism, most probably a bryozoan. The pluricolumnal is heteromorphic, possibly N1N (*sensu* Webster 1974), the central columnal being the lower. Column and articular facet are both circular in section with a marginal crenularium of coarse crenulae; other features of the articular facet not seen. Latera convex, unsculptured, sloping to a median ridge at mid-height.

Zooids of bryozoan close-packed, distinctly larger than corallite moulds of *Favosites* cf. *aspera* (see above), tetragonal to hexagonal in outline, arranged in columns.

Figure 1. Specimen CAMSM A60105, not **Periechocrinus moniliformis** ***(Miller, 1821) as indicated on the label and in the electronic catalogue, but a Silurian (Llandovery, Telychian) crinoid stem that was formerly encrusted by a bryozoan colony. Although neither the bryozoan nor the crinoid is identifiable to even familial level, the specimen is nevertheless of interest, posing questions concerning its palaeoecology and taphonomy. Scale bar represents 10 mm. Specimen unwhitened.***

Discussion

> "... the surreal incongruity of a hatstand in the sky" (Larkin 1985, p. 65).

What's in a name? Putting a name on any specimen implies a confidence on the part of the identifier who is safe in their systematic know-how that is not conveyed by, for example, a more restrained 'crinoid sp. indet.' But knowing what a name actually implies is another thing entirely. There never has been a correctly named crinoid called *Periechocrinites moniliformis* (Miller) as was explained by Ramsbottom (1951, pp. 1040-1041). Miller (1821, pp. 115-116, pl. opposite p. 114, fig. 9) attached the name *Actinocrinites moniliformis* to a heteromorphic, (apparently) radicular pluricolumnal retaining the lowest circlet of cup plates, either basals or infrabasals (Figure 2). However, the specimen retained insufficient characters to define a new species, the type material is both lost and poorly illustrated, and Miller thought that *A. moniliformis* occurred in both the transition limestone (Silurian = Much Wenlock Limestone Formation) and the mountain limestone (Mississippian), an improbable range not shown by any other species of crinoid. Phillips (1839, p. 673, pl. 18, fig. 4) attached the name *Actinocrinites moniliformis*, Miller, to well-preserved specimens retaining crowns (Fig. 3), but their relation to Miller's species is doubtful. The basal plates of Miller's crinoid lack the median ridges seen on that of the species illustrated by Phillips, the latter lacking abundant radices attached to the proxistele. It is the latter taxon that is recognised as *Periechocrinus costatus* (Austin and Austin, 1843), "... a new name for *Actinocrinites moniliformis* Phillips *non* Miller" (Ramsbottom 1951, p. 1041).

The crinoid pluricolumnal on CAMSM A60105 bears some similarities to Miller's illustration of *A. moniliformis* (compare Figs 1 and 2). However, the specimen is even more incomplete than that of Miller, apart from being older. Almost certainly, CAMSM A60105 is something else, although this crinoid is too incomplete to say just what; it is either a cladid or camerate from the size and geometry of the pluricolumnal. Anyone mining the Sedgwick Museum's catalogue for some Silurian or crinoidal database will find little to interest then from this entry and, unless they use caution, it will be a case of 'rubbish in, rubbish out'.

Nevertheless, we wish to emphasise the positive points of this incorrect identification. The specimen is correctly identified as a crinoid, a group that

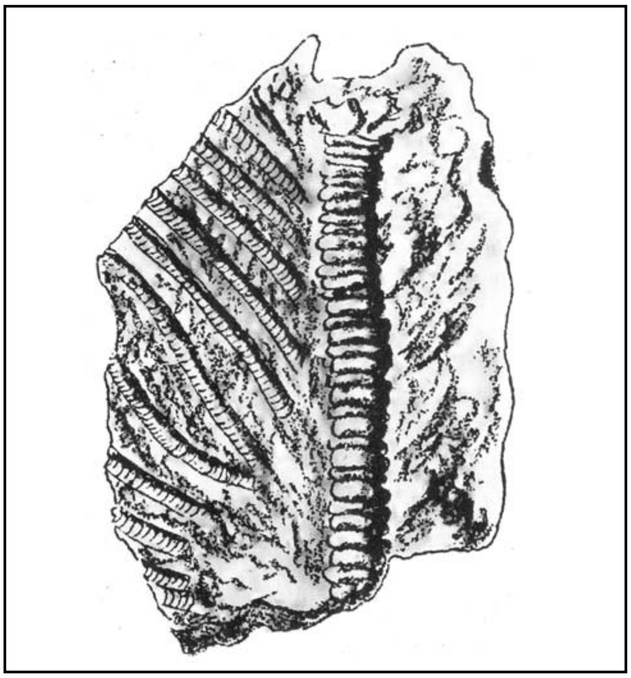

Figure 2. **Actinocrinites moniliformis** ***Miller (after Miller 1821, pl. opposite p. 114, fig. 9), locality and horizon unknown. A heteromorphic pluricolumnal composed of columnals with convex, unsculptured latera; strongly developed radices on the left side only (or are these the arms of another crinoid?); and a few cup plates of the basal or infrabasal circlet. The incomplete specimen is inadequate for the erection of a new species, the illustration is poor and the material lost. CAMSM A60105 (Fig. 1) bears a superficial resemblance to a short length of this column, but so would many specimens of diverse origins from the Ordovician to Mississippian of the British Isles and elsewhere. Note that Miller's (unfortunately) poor illustrations were criticised at the time of publication (Knell 2000, p. 102). Presumed x 1.***

remains imperfectly known from the British Llandovery (Donovan *et al*. 2008 & in press). Every new record from the Llandovery is potentially interesting. It is unfortunate that CAMSM A60105 is not identifiable to genus or species, but there are other points of interest to this specimen. The palaeoecological association of a crinoid and an epizoozoic (*sensu* Taylor and Wilson 2002) bryozoan is unusual in the Silurian of the British Isles. The only other record of a Llandovery crinoid/bryozoan association was figured by Donovan and Harper (2003, fig. 2C), but the morphologies of these taxa differ markedly from those in Figure 1 herein. Other epizoozoans, namely the holes and pits of borers and embedders, are well known from the British Wenlock Crinoidea (e.g., Widdison 2001b; Donovan and Lewis 2010, fig. 2), but remain unreported from the Llandovery. Thus, CAMSM A60105 is significant in preserving a rare crinoid-animal interaction from the Llandovery. Further, although the specimen is incomplete, it gives the impression that the bryozoan continued right around the pluricolumnal (Figure 1), which would imply that the crinoid was alive and the column elevated above the sea floor when infested, adding to its significance. Until now, the catalogue entry did not mention the bryozoan, so that it has hitherto been 'invisible' to bryozoologists.

It is also apparent that CAMSM A60105 represents an unusual juxtaposition of two modes of preservation. The echinoderm endoskeleton is composed of high-magnesium calcite in life, which is metastable and re-equilibriates to low-magnesium calcite after

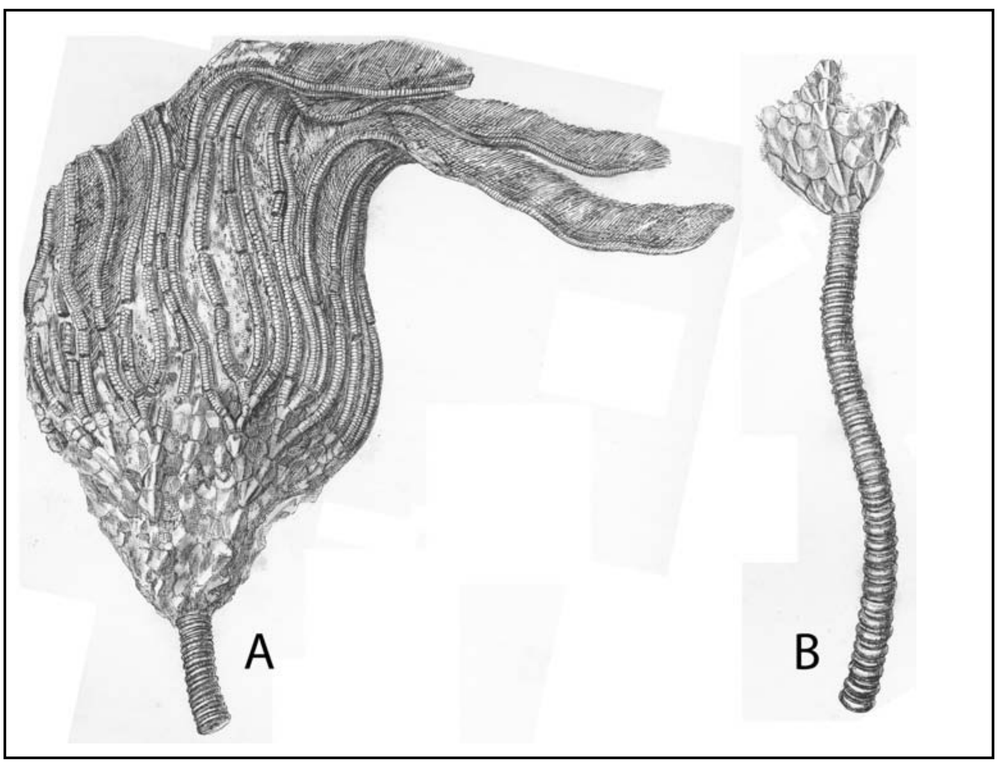

Figure 3. **Actinocrinites moniliformis** ***Phillips, 1839, non Miller, 1821 (after Phillips 1839, pl. 18, fig. 4) =*** **Periechocrinus costatus** ***(Austin & Austin, 1843), almost certainly from the Much Wenlock Limestone Formation (Wenlock, Homerian) of Dudley, Worcestershire. (A) lectotype (Donovan et al. in press); (B) syntype. The whereabouts of these specimens is unknown. Presumed x 1.***

death (Donovan 1991, p. 257). This part of the fossil is still calcitic. Bryozoans may be calcitic or aragonitic or both (Tucker 1991, table 4.1). The mouldic preservation of the bryozoan, which would have been in intimate contact with the crinoid in life, suggests that it was aragonitic, metastable and lost through dissolution. But CAMSM A60106 - labelled as *Favosites* cf. *aspera* - shows a similar style of preservation, yet the tabulate corals have a calcitic skeleton. The morphology of this mould, lacking obvious tabulae, may instead represent a bryozoan, although some articulated brachiopods (but not all of them), which were originally calcitic, are also preserved as moulds. We offer no definitive solution for this conundrum, just note it.

Conclusion

The name attached to CAMSM A60105 is of a crinoid taxon that was known to be unrecognisable as early as the early 1840s. The specimen is too incomplete to be confidently named, yet it is scientific treasure trove, preserving a rare crinoid/bryozoan life association from the Llandovery of the British Isles and posing questions regarding the mode of preservation of diverse, calcareous invertebrate skeletons. The name in the electronic register of the Sedgwick Museum was incorrect, but it drew our attention to a specimen that we might otherwise have ignored. Even when wrong, searching an electronic museum catalogue may include indications of treasures hidden behind a spurious name.

Acknowledgements

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THE EARTH SCIENCES REVIEW: TWENTY YEARS ON

by Jeff Liston

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The current round of cuts resulting from the global financial crisis once again places museum collections in a vulnerable position in terms of resource allocations from funders national, regional and private. Often, cuts in institutional funding are proposed in the context of being designed to reshape an organisation for a more streamlined role, better designed to meet the challenges of the future. But however well museums are redesigned, they rarely escape being viewed as legitimate targets for funding cuts whenever a new round of belt-tightening comes up. The inherent implication of the language of institutional reshaping is that a certain amount of protection, if not immunity, will be conferred on the museum come the next round - but that rarely happens. This is true from all ranges of funding sources: it is simply hard in political terms for funders to justify resources going to cultural preservation instead of hospitals or nursery education.

Within museums, geological collections traditionally have a particularly hard time in terms of funding and justifying their existence. Whereas artworks, archaeological, historical or ethnographic objects appear to have an intuitively obvious value to external assessors, arguing the case for natural science in general, and geology in particular, has always been an uphill struggle.

So it is worth reflecting on an unusual manifestation of this phenomenon in the late 1980s, when cuts in funding actually led to an increase in funding for geological museum collections.....at least for some.

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Background - University Funding

One of the hallmarks of the 1980s Conservative Government's approach to Higher Education (as well as other sectors), was the introduction of market forces and competition. The University Grants Committee [1] gave way to the Universities' Funding Council, with the emphasis being shifted to a limited quantity of money that was to be competed for by the relevant institutions, in more direct contest than before. There were winners, and losers.

[1] The University Grants Committee (UGC) was an advisory committee of the British Government that advised on the distribution of grant funding amongst the British universities. The creation of the UGC was first proposed in 1904 in the report of a committee chaired by Lord Haldane, but only came into being after the First World War, in order to address a need for a mechanism to channel funds to universities, which had suffered from neglect in funding during this period of conflict. The UGC's role at this time was to examine the financial needs of the universities and to advise on grants, but it did not have a remit to plan for the development of universities. This situation changed after the Second World War, when the 1946 Barlow Report recommended that the UGC take on a planning role for the university sector, to ensure that universities were adequate for national needs during post-war reconstruction. This was also in the wake of the 1944 Education Act, which had aimed to increase the number of school leavers qualified to enter higher education, thus requiring a period of expansion for the universities that needed to be planned by the UGC. During the post-war years the UGC continued to have a strategic role in the development of the university sector, acting as a buffer between government and the interests of the universities. In 1964 responsibility for the UGC was transferred from the Treasury to the newly constituted Department of Education and Science.
The UGC was wound up on 1 April 1989 by the 1988 Education Reform Act, with its powers transferred to a new body, the Universities Funding Council. This was less of a 'buffer' between government and the needs of universities, than a body that reported directly to the Westminster Parliament, distributing central government's funds to universities for the provision of education and the undertaking of research. Critically, there was a shift in emphasis to a limited quantity of money that was to be competed for by the relevant institutions, in more direct contest than before. The UFC in turn was wound up a mere 3 years later by the 1992 Further and Higher Education Act, which replaced its function with three regional bodies: today, these are the Higher Education Funding Council for England (HEFCE, www.hefce.ac.uk/research/initiats/museum , the Higher Education Funding Council for Wales (HEFCW) and the Scottish Further and Higher Education Funding Council (SFC, www.sfc.ac.uk - replaced the SFEFC Scottish Further Education Funding Council and SHEFC, the Scottish Higher Education Funding Council in October 2005).

Similarly, the Earth Sciences Review was conducted by the UGC, as the first of three subject areas in the Physical Sciences to be considered for reorganisation: smaller than both Chemistry and Physics, Earth Sciences was seen as a suitable 'guinea pig' to test the process with. Announced on 27/10/1986 with the sending of the UGC Chairman's consultative letter (UGC circular letter 19/86, para 1.2 of Oxburgh 1987) to all 31 of the Vice-Chancellors and Principals, inviting their comments on the future organisation of Earth Science teaching and research. In addition, responses were invited from a variety of interested organisations, from professional bodies to government departments and funding councils. Amongst almost one hundred responses, the Geological Curators' Group (noted at the 17/3/1987 Earth Sciences Review Committee meeting, and in Appendix A of Oxburgh 1987) underlined that collections were a basic resource for Teaching and Research, that needed to be safeguarded in ANY reorganisation, regardless of what form it took). Partly as a result of this representation, the first report of the Earth Sciences Review under the chairmanship of ER Oxburgh (Professor of Mineralogy and Petrology, University of Cambridge) '**Strengthening University Earth Sciences**', published on 5th May 1987, featured a section on Museums and Collections (paras 6.40-6.42, Oxburgh 1987). Within this, it drew particular attention to the importance of collections for four key functions of a university: for teaching, as sources of research material, as repositories of international reference material, and for public display. It thus specifically recommended that the special costs of curating collections that were internationally important had to be taken into account and provided for in any prospective reorganisation.

In November 1987, the Earth Sciences Review issued a departmental questionnaire (see Appendix 3, O'Hara 1989) for each earth science department to submit data on academic staff, buildings, publications, courses taught etc etc (O'Hara 1989). Within that questionnaire was Form 8, a series of questions on Museums and Collections. These were mostly predictable questions about collection size, numbers of specimens of special status (type, figured or cited) or historical importance, use of the collections, how fully catalogued they were, numbers of designated staff and what degree of public access there was per annum. These questions led to an unusually cutthroat scenario, with institutions producing figures for the size of the collections they cared for as a way of estimating the significance of the work that they did. Ironically, this sometimes meant that the smaller collections did not do so well, as their material could be very accurately quantified, and the exact size of the larger collections were estimated in traditional (often slightly exaggerated) museum fashion. This became important, as in some cases those figures were to be used to justify the allocation of new long-term recurrent resources to institutions, to cover newly-created ongoing curatorial posts.

At the end of 1987, the Earth Sciences Review charged Sir Alwyn Williams (at the time, Principal of the University of Glasgow) to chair a Museums and Collections Committee, to ensure that these collections were taken into account in the face of the imminent reorganisation of Earth Sciences, and that appropriate recommendations be made for the future, with particular reference for the ongoing curation of international reference material, including the relocation of collections, where necessary (para 3.87, O'Hara 1989). At their second meeting (19th May 1988), this Committee finalised their report for the Earth Science Review's June 1988 meeting, which in turn passed it to a further group chaired by I. G. Gass (Professor, Earth Sciences, Open University) to finalise recommendations (para 3.88, O'Hara 1989). The most important of the Williams Committee's proposals was the designation of five university museums - Cambridge, Oxford, Manchester, Birmingham and Glasgow - with type collections of national importance as major collection centres, which would ultimately hold type figured and cited specimens, in conjunction with national and selected local authority museums (para 3.90, O'Hara 1989). This designation required special funding, in order to secure adequate care for the existing collections of these museums, as well as those of type and other material to be transferred from other universities. The paramount criteria were the provision of adequate long-term care, curation, housing and conservation. The Williams Report also recommended that any redistribution of collections from departments that were not one of the five collection centres, should be decided on by those individual departments, taking advice, where necessary, from the Geological Curators' Group (para 4.11, Appendix 4, O'Hara 1989).

The transferral of collections was a very real possibility - because although this article is focussed on the funding gained by some institutions, the Earth Sciences Review was fundamentally a move to reduce expenditure for the government on earth sciences (Anonymous 1988), and that meant closing departments, and the salient jobs being redeployed or simply axed. Inevitably, this provoked criticism, one letter to The Independent (Moorbath, 14/11/1989, just prior to the release of the final report and see also

Skinner 1989b) describing the Earth Sciences Review as an "over-heated and exaggerated….so-called rationalisation process". Perhaps most controversial of all was the axing of Hull University's Earth Sciences Department. Significant scientifically important collection material was at risk, and needed to be rehoused: there was a need for provision of resources to ensure adequate care of and access to specimens in the future, as well as the redeployment of staff- in this case Derek Siveter, who was transferred in a curatorial role to Oxford University.

Such redeployment did not perhaps turn out to be the gift it might appear to individuals involved. For Derek Siveter, for example, having to move from Hull to Oxford, the relocation expenses were only designed to pay for removal vans, and certainly did not take into account the huge financial costs of having to move from a 3 bedroom house in the Hull area to the inflated property market of Oxford, at more than twice the price for an equivalent property (Siveter pers. comm.).

Ongoing Recurrent Funding for Designated Collection Centres

In December 1989, the Earth Sciences Review's second (and final) report '**Building for Success in the Earth Sciences**' (O'Hara 1989) was published. Given that it had been agreed that the collection centres would receive further funding in order to care appropriately for the incoming collections as well as their own, in order to provide "adequate long-term care, curation, housing and conservation" (para 3.iv, UFC circular letter LF1404A, Skinner 1989a) for their own and any transferred material, posts would need to be created, to take on board the responsibility of the ongoing collections care that came with receiving the collections. In order to assess the degree to which this would be required, a Curators' Steering Committee was established, on which all the newly-designated collection centres were represented: chaired by WJ Kennedy (Oxford), it consisted of David Price (Cambridge, later replaced by David Norman), Graham Durant (Glasgow), John Nudds (Manchester) & Peter Lawrence (Birmingham, later replaced by Paul Smith), plus Robin Cocks of the British Museum (Natural History) (now the Natural History Museum London) [2] (Appendix 1, O'Hara 1989). Two independent assessors, WD Ian Rolfe (former Deputy Director of the Hunterian Museum, at the time Keeper of Geology, Royal Museum of Scotland) and MG Bassett (Keeper, Department of Geology, National Museum of Wales) were appointed to assess bids for resources, both recurrent and non-recurrent, submitted by the collection centres (paras 3.96 and 3.100, O'Hara 1989).

It is important to note that the posts to be created were not temporary posts to process or facilitate the incorporation of those collections on a short term basis, but were recognised as ongoing permanent (or, to use the jargon of today, 'non-time-limited') contracts. In this respect, and as one of the largest beneficiaries UK-wide from the Earth Sciences Review process, the experience of the Hunterian Museum serves as an interesting example of an institution that benefited at the time, in terms of reviewing how it has met this challenge of new collections and new resources over the past twenty years, armed with the huge windfall that the Earth Sciences Review provided for it.

Initially, it might come as a surprise to some that a Scottish university was such a significant beneficiary. However, the 1986 Miles Committee Report to the Museums and Galleries Commission noted (in para 4.3, page 31, Chapter 4, Miles 1986) that Scottish universities - in particular Edinburgh and Glasgow - had a relatively greater number (and higher quality) of museum collections than elsewhere in the UK. With the significance of the material established, it is also interesting to note a further observation of the Miles Committee: "we were left with the impression that many university collections are curated and maintained by accident" (in para 4.3, page 32, Chapter 4, Miles 1986). In the context of this observation, it is perhaps unsurprising that Glasgow saw the most posts created as a result of the Earth Sciences Review.

Assessing the Required Ongoing Resources

The starting point for the Curators' Steering Committee in terms of the number of curators required per collection, was the metric given in the Museums and Collections Committee's final report (para 4.2, Appendix 4, O'Hara 1989), that for geological collections of such international importance there should be a curator for every 200,000 geological specimens, and one geological conservator. The Assessors looked further into the question of comparators for benchmarks elsewhere in the sector, to

[2] During the two years of the committee, there were changes to this initial line-up: David Price died in post, so was replaced by David Norman for Cambridge. Peter Lawrence's position was similarly taken over by Paul Smith for Birmingham (Nudds pers. comm.).

see how this figure compared with elsewhere for staff:specimen resources. Naturally, this entailed looking at the staff resources for the Nationals, including the Natural History Museum (then the British Museum (Natural History)) in London. Although the latter was close to 1 staff member for every 120,000 specimens, and the Assessors noted that a figure of 1:100,000 was preferable, the National Museum of Wales and the National Museums of Scotland had a figure closer to 1 dedicated collection staff member to every 20,000 specimens (Bassett & Rolfe 1989). So, in using the figure of 1:200,000, the metric used by the Curators' Steering Committee Assessors to calculate the required number of geological curators for each of the university collections involved in the Earth Sciences Review, was far from generous when compared to the natural benchmarks within the sector.

What did this mean in real terms for a given institution? Taking the University of Glasgow's Hunterian Museum as an example, the overall figures used were 200,000 rock specimens, 30,000 mineral specimens, half a million fossil specimens, and over 20,000 thin-sections, with a further 12,000 type/figured/cited specimens - a total of over 760,000 specimens. This figure was then further enlarged by the planned addition of the collections from the universities of Dundee and Strathclyde geology departments, to a total of 907,000 specimens. At the time, there were only two geological curators in post [3], and the metric from the Earth Sciences Review as noted in the Assessors' Report (Bassett & Rolfe 1989) meant that two additional geological curators (and a geological conservator) were required to supplement the two pre-existing geological curators - the financial support for those ongoing recurrent costs being quantified at £76K (including overheads) in April 1991 (£111,773 equivalent in April 2011). The expectation in the Museums and Collections Committee's final report is clear - the posts already funded by the institution, will continue to be funded by the institution, as any fall-off in staff numbers would mean that a collection centre was automatically below minimum adequate cover to fulfil its designated role.

Financial support for ongoing costs to bring staffing numbers up to the required level for minimum adequate cover was not the sole area that the five main collection centre institutions received financial support for. Money was also allocated on the basis of building works for adequate store provision, costs of collection movement from other institutions - however, all of these were non-recurrent, one-off payments from the UFC.

Although the arrangements for funding were viewed to be adequate (as the figures were based on submissions from the collection centres concerned), concerns were already being expressed as early as 1992 as to whether the arrangements would prove to be sufficient in the longer term (Edwards 1992).

Twenty years on from Implementation

It is interesting to compare the staffing levels in 2011 to those levels from the time of the Review (Table 1). It is important to note a number of key definitions that apply to this table, as laid down in O'Hara 1989 and Bassett & Rolfe 1989, for the purposes of the creation of the newly-funded posts:

'Geological Conservator' is defined as a full-time member of staff, formally trained in conservation, working solely on the geological collections. This role was often defined by institutions as that of a technician. In 2011, only the Sedgwick have retained their geological conservator, although Birmingham's current curator has conservation experience and their former geological conservator retains an advisory role with the Lapworth Museum. 'Geological Curator' is defined as a permanent full-time member of staff employed as a curator and solely working on the geological collections, without responsibility for other collections or other duties such as teaching. Local variations in job nomenclature meant that posts were not always give the correct title of geological curator, despite that being the job done. As such, it is worth noting that the term 'curator' at the Sedgwick Museum is a misnomer, as they have traditionally been advisory roles in addition to the responsibilities of the individual's academic department. In this case, the job of geological curator (in the sense defined above) is actually carried out by the collection managers and assistants [4].
The evident fall-off in professional geological posts in the collection centres raises the question as to where the recurrently-funded positions have gone.

[3] The picture of precisely what the Hunterian had as curatorial staff cover at this time is slightly muddied by the fact that both of the geological curators had 25% of their time allocated by contract to teaching for the University of Glasgow's geology department. So effectively this meant only 1.5 full time equivalent geological curators were in post at this time, instead of 2. This appears to be one of the reasons why the Bid Assessors Report (para 3.6, Bassett & Rolfe 1989) specified that "Staff should be appointed on Other Related" [i.e. not Academic] "scales and assigned specifically to curatorial work, with carefully specified and limited teaching and research roles, if any."

Institution Collection Centre	Non-recurrent (one-off payments for building, storage, collection transfer etc.)	Staffing level prior to 1991	Recurrent Staff Funding Received	Designated Geological Collection Posts in 1991 following funding release (Bassett & Rolfe 1989)	Posts in 2011
Cambridge	£468K	1 geological curator + 4 geological technicians	£101K (to bring staff to 5 geol curators + 1 geol conservator)	2 geological curators + 7 geological technicians	3 (equivalent) geological curators + 1 geological conservator
Glasgow	£313K	1.5 geological curators + 1 geological technician	£76K (to bring staff to 4 geol curators + 1 geol conservator)	3.5 geological curators + 2 geological technicians	2 geological curators
Oxford	£447K	2 geological curators	£40K (to bring staff to 3 geol curators + 1 geol conservator)	3.4 geological curators + 2.2 geological technicians	2 assistant geological curators
Manchester	£198K	0 geological curators	£64K (to bring staff to 2 geol curators + 1 geol conservator)	2 geological curators + 1 geological technician	1 geological curator
Birmingham	£79K	2 geological technicians	£24K (to bring staff to 1 geol curators + 1 geol conservator)	1 geological curator + 2 geological technicians	1 geological curator

Table 1.

Fundamentally, are the collection centres still receiving the recurrent funds that were intended to come with their designated responsibilities? Although the figures disbursed by the different funding councils for the use of the collection centres over the twenty years are - in principle - a matter of public record in their annual reports and grant letters, in practice, the perpetual reconstitution of funding councils since the end of the UFC in 1992 has not aided clarity. In particular, the move to have HEFCE's Museums and Galleries Fund managed externally by the Arts and Humanities Research Board, then from 2005-2010 by the Arts and Humanities Research Council, has added a layer of opacity to attempts to discern the funding trail for earth sciences in university museums. A later change, with the Funding Councils electing to cease separating the ESR recurrent component from the total block grant as a discrete and distinct element also does not help, but in spite of this, it does not appear that the figures fell suddenly and drastically at any point as the consequence of some unannounced and uncommunicated decision to prematurely curtail the Earth Sciences Review funding stream. (The recent decision to inexplicably terminate the Sedgwick Museum's funding, and apparently transfer it wholesale to the Scott Polar Research Institute's Polar Museum, though raising extremely serious questions about central support for designated collection centres, is very important and requires urgent action, but is a separate issue to the pattern dealt with in this paper.) As such, the question naturally arises as to whether the redirection of monies is a decision being made not at funding council level, but within the recipient institutions themselves - either within the universities' management, or within the individual museum department, as they decide not to replace geological posts that they are receiving recurrent funding for. The situation currently facing Oxford with Derek Siveter's retirement at the end of September, is thus a typical one: the OUMNH is left with only two assistant curators and two support staff to be responsible as permanent staff for the curation and conservation of the entire collection, with no indication as yet as to when (or if) Derek's post, and a frozen support post which should have been filled since July, will be filled.

4 It is also worth noting, in this qualitative sense, that the recommendation contained in the Bid Assessors' Report (para 3.7, Bassett & Rolfe 1989) that applicants for ESR-funded curatorial posts "should be required to hold the Museums Diploma" was regularly ignored. In many cases, the requirement of a post-graduate qualification for a post was seen as making the post too expensive by at least some of the institutions, although a museum qualification was often cited in job adverts as 'desirable, but not essential'.

How could such a misalignment or disjunction have come to pass between the conclusions of a Government review, and real collection posts still in existence? As already noted, the continued reinvention of funding bodies is unlikely to have helped. It also has to be acknowledged that the problem may also in part be due to 'revolving door' management policies at institutions: at a time when many museums lurch from one short-term infrastructure project to the next (either a wholesale collections move, or large scale display work - thus continually disrupting their core curation, rather than consolidating it or eliminating backlogs), it is easy to see how such funding might have been misinterpreted by incoming managers as being in the same light as these short-term tasks… And once initially made, it would be somewhat difficult for subsequent managers not to repeat the mistake of failing to reappoint lost posts, if unaware that the institution was still receiving dedicated funding for those positions. Such a shift might also be reinforced by other 'competing' disciplines within a university museum, that fail to understand the scale of the collections issues involved with geological material: two former directors of university museum collection centres have put it to me directly that the geology collections were seen by other curators in their department as 'oversubscribed' with curators, as many other collections (in the sense of discipline areas) had no such dedicated staff. Such an opinion seems to ignore the fact that in contrast with other museum disciplines, the earth sciences had undergone a rigorous Government-driven review, which had assessed what the minimum adequate level for collection care was at each institution - not something to be lightly second-guessed by departmental managers [5]. Again, the created posts were not an arbitrary short-term move, but were ongoing dedicated positions, designed to cope with the increased level of work resulting from the collection centres receiving the geological collections of closed university departments, in addition to dealing with already acquired material, and commensurate recurrent core funding was received on that basis. The departments that the supplementary material came from were then closed as an outcome of that process - and the collection centres were allocated recurrent funding to look after their collections in their stead in perpetuity. No other museum discipline has been subjected to such rigorous benchmarking.

The mechanics of such a shift in curatorial balance within a university museum can transpire in many ways. Taking the Hunterian again as an example: within ten years of the Earth Sciences Review funding being allocated, the two geological curators, that had originally been in post when the two additional ones were taken on with Earth Science Review money, left the Hunterian (one retiring, the other moving job to Australia). Critically, their posts were not replaced, thus allowing the numbers of curators to drop below the necessary minimum quota to maintain the collections, from four to two, as some form of 'levelling' across the department, to give some imagined parity with other sections. Geological curators 3 and 4 became merely geological curators 1 and 2 - with double the workload. And this non-replacement of ESR-created posts is not restricted to Glasgow.

It is small wonder that, with the non-replacement of such geological curator posts at designated collection centres, that any remaining collection staff have struggled to cope with the logistical implications of those collections: evidence of the resulting struggle with the non-replacement of such posts can be found across the collection centres. Not only is it observable in the scale of the ongoing backlog of uncatalogued specimens in the pre-Earth Sciences Review collections, but also in the failure to cope with the many thousands of specimens that have subsequently arrived at the collection centres. By the original metric, which still forms the basis of the funding that the five collection centres' parent institutions still receive today, all of those collection centres are operating at staffing levels that (as per the Earth Sciences Review) fail to provide the necessary minimum collection cover for their geological material, and this conclusion is supported by the anecdotes of overdue collection work, including (from one curator) tales of a collection of sulphides that formed part of material from one of the closed departments, that were subsequently left in inappropriately damp conditions for the best part of two decades, owing to lack of time to process the material (pers. comm.. S. Perry). And what of the situation at Oxford, with Derek Siveter retiring this year? Will his post be maintained, as was intended in the decisions of the ESR? The future, as a writer once remarked, is uncertain, even if the past is always clear.

[5] Such an opinion also seems to largely ignore the fact that by volume, by weight, by number the natural sciences (and geology in particular) will always vastly outweigh the other collections of most multidisciplinary institutional repositories. Regardless of opinions on its subjective value, there is a very substantial demand in terms of resources required to manage material of this kind.

So what is the lesson from history here? Plenty of geological collections are in crisis these days, with staff reducing further and further as natural wastage is allowed to ease strain on departmental budgets, or to redeploy staff resources to sections seen as 'more worthy'. What is interesting here is what happens, even when institutions supposedly come out ahead of the game in terms of funding, and how even then it does not mean any long-term security for the collections involved whatsoever. Did the Earth Sciences Review get it wrong - were institutions being provided with more staff than required to curate their collections to a minimum adequate level? Apparently not, given the aforementioned ongoing backlogs, and failures to get to grips with the material originally received as part of the Earth Sciences Review by the 'successful' bidding institutions. Given the undertakings on processing backlogs of material that were made when institutions achieved accreditation, the loss of staff will inevitably impact on the feasibility of meeting those promised targets, thus risking their accredited status, with consequent exclusion from many major funding sources. But this is a clear indication - if any were needed - that no matter what agreements may be reached to look after collections as they are being handed over, no matter what arrangements are made for staff to be employed 'in perpetuity' to look after them....there are absolutely no guarantees. Funders can dictate and change goalposts, no matter what government groups made the original decision, or what bequest terms were set down for the care of a collection. No matter what conditions are made, what safeguards are laid down, they can all be forgotten with a simple change of management (which can take place these days quite easily over a mere five years) - and any collection can become a collection in crisis.

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BOOK REVIEWS

Living Dinosaurs: the evolutionary history of modern birds
Gareth Dyke and Gary Kaiser (eds.)
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As pointed out in the foreword of this book, there is now little doubt that, "… birds are related to some dinosaurs". Quite rightly, little more space is wasted arguing any other theory (there are few serious researchers left who are in contention with the avian-dinosaur hypothesis, and the arguments involved really aren't that convincing). Although covered in the early chapters of the book, the main thrust is really concerned, not with issues such as the feathered dinosaurs, or basal avian oddities (like the Enantiornithes, or 'opposite birds'), but with the evolution of the 'modern birds' - the so-called Neornithes. But, concentrating on Neornithes doesn't mean that the authors have cut out the contentious issues or skipped problematic taxa. Quite the opposite in fact - the evolutionary history of modern birds is full of unanswered questions and missing fossils. Written in the forward to this book is a very pertinent sentence: "The two main problems facing paleontologists [sic] over the next few years will be the same as those for the past century: 'What did the ancestors of modern birds look like?' and 'Where did the living groups of birds come from?' ".

Most of Living Dinosaurs deals with trying to answer these questions and due to the scarceness of birds in the fossil record, especially before the K-T boundary, there are plenty of hypotheses to discuss. Despite the shortage of avian fossils, this is an exciting time for avian palaeontologists - recent finds from around the world (both in the field and from further study of museum specimens), have helped our knowledge of bird evolution come on more in the past decade, than it did in the entire previous century.

The book is illustrated throughout with line drawings, and black-and-white photographs (some of which are repeated again in the colour plates towards the centre of the book). These illustrations are not supposed to be pretty, or imaginative - they are technical diagrams, which simply help to prove a point, or clarify an anatomical feature. They are generally of high standard and thoroughly useful to the reader.

The book is split into four parts, essentially: The deep evolutionary history of modern birds, the diversity of modern birds, the evolution of key avian attributes, and conservation and climate change. These parts are then divided into a series of review papers by some of the world's leading authorities in avian palaeontology, as well as some newer, up-and-coming researchers who are currently making a name for themselves in this highly competitive and niche area of palaeontology. But don't expect a quirky, 'popular science' style of writing - this is a serious tome of 422 pages, consisting of 23 separate scholarly articles. Neither is the price to be sniffed at - £50 rrp reflects the fact that this is a specialist book really only for people with a keen interest or professional connection with the subject. Having said that, if you are responsible for any bird fossils at all, or your museum's education department runs any sort of events or workshops involving dinosaurs and/or birds, then this book is the easiest and quickest way of getting right up-to-date with the current thinking about the evolution of modern birds.

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THE GEOLOGICAL CURATOR

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Two issues of The Geological Curator are published for each year (usually in the Spring and the Autumn); a complete volume consists of ten issues (covering five years) and an index.

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3. Line spacing. Your hard copy should be double spaced. If possible, single space your copy on disk. Use a single (hard) carriage return at the end of each paragraph.
4. Single space-bar between words, double space-bar between sentences.
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