1-1-2004

Silicified early devonian trilobites from Brogans Creek, New South Wales

Gregory D. Edgecombe
Australian Museum, greged@austmus.gov.au

Anthony J. Wright
University of Wollongong, awright@uow.edu.au

Silicified early devonian trilobites from Brogans Creek, New South Wales

Abstract

Trilobites in an Emsian silicified fauna from the Carwell Creek Formation at Brogans Creek SE of Mudgee, NSW, include Acanthopyge (Jasperia) bifida, Dentaloscutellum hudsoni and Proetus nemus, all originally described from the Taemas area of NSW, together with Sthenarocalymene. Proetus nemus was known from limited material at Taemas, but is the most abundant species at Brogans Creek. Fuller description substantiates membership in Proetus (=Devonoproetus), rather than Ryckholtia, Longiproetus or Rhenocynproetus. Early ontogenetic stages of the trilobites are lacking at Brogans Creek, in contrast to Taemas. Conodonts co-occurring with the shelly fauna at Brogans Creek and at Taemas include Polygnathus nothoperbonus, which indicates the Polygnathus perbonus Conodont Zone (medial Emsian).

Keywords

GeoQuest

Disciplines

Medicine and Health Sciences | Social and Behavioral Sciences

Publication Details

Edgecombe, G. D. & Wright, A. J. (2004). Silicified early devonian trilobites from Brogans Creek, New South Wales. Proceedings of the Linnean Society of New South Wales, 124 177-188.

Silicified Early Devonian Trilobites from Brogans Creek, New South Wales

Gregory D. Edgecombe[1] and Anthony J. Wright[2]

[1]Australian Museum, 6 College Street, Sydney, NSW 2010 (greged@austmus.gov.au);
[2]School of Earth and Environmental Sciences, University of Wollongong, Wollongong, NSW 2522 (tony_wright@uow.edu.au)

Edgecombe, G.D. and Wright, A.J. (2004). Silicified Early Devonian trilobites from Brogans Creek, New South Wales. *Proceedings of the Linnean Society of New South Wales* **124**, 177-188.

Trilobites in an Emsian silicified fauna from the Carwell Creek Formation at Brogans Creek SE of Mudgee, NSW, include *Acanthopyge (Jasperia) bifida*, *Dentaloscutellum hudsoni* and *Proetus nemus*, all originally described from the Taemas area of NSW, together with *Sthenarocalymene*. *Proetus nemus* was known from limited material at Taemas, but is the most abundant species at Brogans Creek. Fuller description substantiates membership in *Proetus* (=*Devonoproetus*), rather than *Ryckholtia*, *Longiproetus* or *Rhenocynproetus*. Early ontogenetic stages of the trilobites are lacking at Brogans Creek, in contrast to Taemas. Conodonts co-occurring with the shelly fauna at Brogans Creek and at Taemas include *Polygnathus nothoperbonus*, which indicates the *Polygnathus perbonus* Conodont Zone (medial Emsian).

Manuscript received 16 October 2003, accepted for publication 8 January 2004.

Keywords: Trilobita, Devonian, New South Wales, *Acanthopyge* (*Jasperia*), *Dentaloscutellum*, *Proetus*, *Sthenarocalymene*.

INTRODUCTION

The presence of Devonian limestone at Brogans Creek (Fig. 1), located SE of Mudgee in the central tablelands of NSW, was first noted by Carne and Jones (1919) and later by Lishmund et al. (1986). Fossils from the limestone were discussed in detail by Colquhoun (1998) and Colquhoun and Meakin in Colquhoun et al. (in Meakin and Morgan 1999). Colquhoun (1995) illustrated the conodonts *Pandorinellina e. exigua* and *Polygnathus nothoperbonus* from Brogans Creek, the latter species considered (after Mawson 1987) to be characteristic of the medial Emsian (*Polygnathus perbonus* zone).

Here we provide the first descriptions of any of the well-preserved and abundant fossils from the quarry at Brogans Creek. A silicified trilobite fauna is of low diversity, but it provides new data on some taxa described from the Taemas area by Chatterton (1971), in particular the proetid *Proetus nemus*.

Stratigraphic assignment and age

The Devonian strata at Brogans Creek were considered part of the Carwell Creek Formation by Colquhoun et al. (1999). The limestones that have yielded the trilobites and other fossils documented here have also yielded (Colquhoun 1995) the medial Emsian conodont *Polygnathus nothoperbonus*, so this limestone is significantly younger than most limestones occurring in the area between the Mudgee and Brogans Creek, with the principal exception of those reported by Pickett (1972) and Colquhoun (1998) from the Mount Knowles Limestone Member of the Carwell Creek Formation and by Pickett (1978) from the Mount Frome Limestone, both located to the E of Mudgee.

Little is known about the sequence of the Devonian strata in the vicinity of the Brogans Creek quarry, and recent land reclaimation operations have concealed formerly productive parts of the abandoned quarries. Colquhoun (1998) stated that the sequence grades upwards from the fossiliferous limestone through crinoidal sandstone into massive shale and volcarenite. The sequence of beds that yielded silicified fossils is about 10 m in thickness. Beds immediately overlying these strata have yielded the tetracorals *Xystriphyllum mitchelli* and *Embolophyllum*, both also described from the Receptaculites Limestone Member at Taemas and Wee Jasper by Pedder et al. (1970).

The similarity of the macrofauna to that from the Receptaculites and Warroo limestone members of the Taemas Formation in the Burrinjuck Dam area of NSW (see Pedder et al. 1970) necessitates some consideration of the ages of these units. Conodont data summarised by Talent et al. (2000) for the Taemas

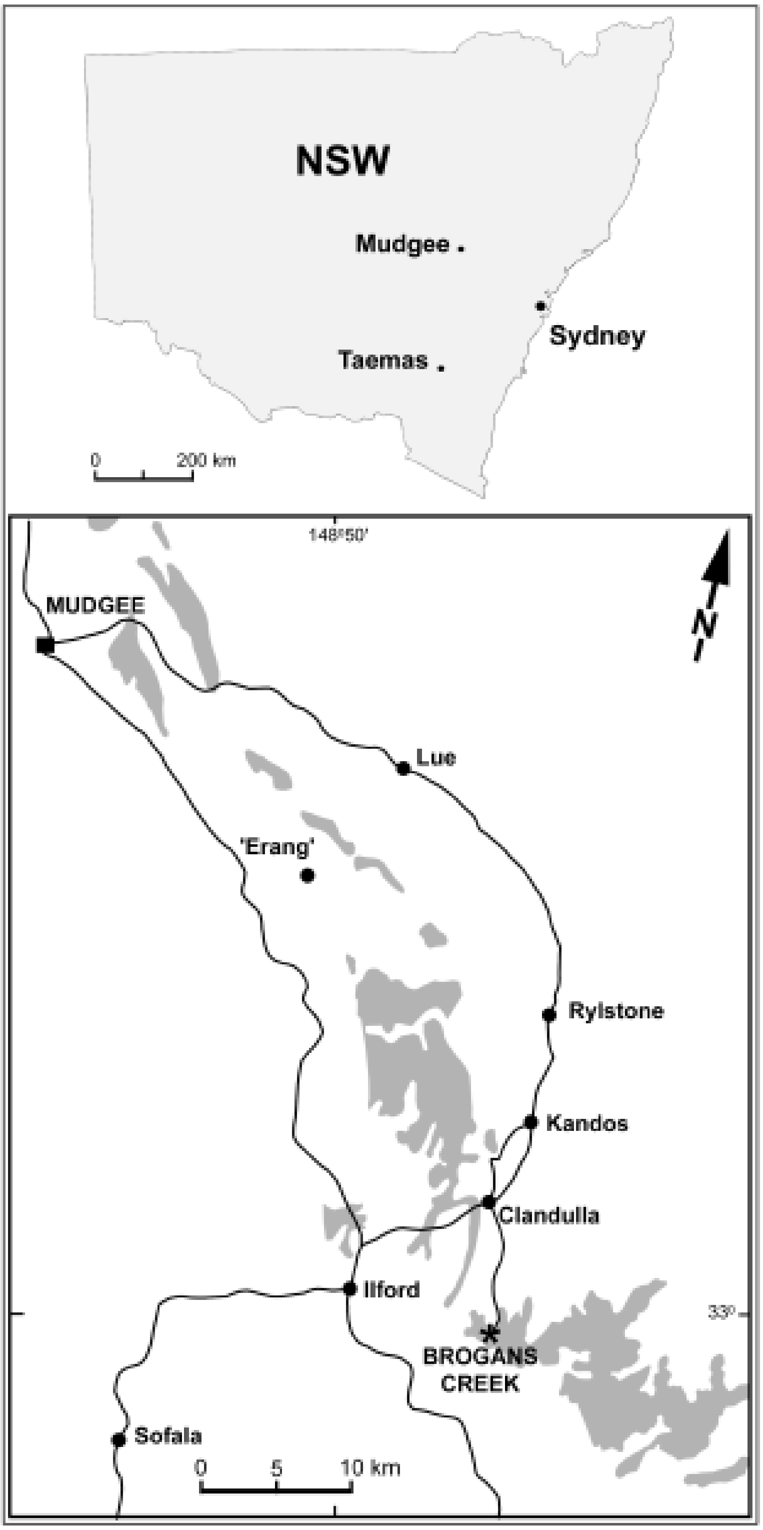

Figure 1. Location of trilobite collection at Brogans Creek. Map of NSW indicates Taemas, where the same species have been described (Chatterton 1971). Shading in inset map (after Colquhoun 1995) shows distribution of Lower Devonian platform sediments.

area of NSW indicate that the Receptaculites and Warroo limestones at Taemas, which overlie the Cavan Formation with its *Polygnathus pireneae* to *P. dehiscens* fauna, are probably early Emsian. Lindley (2002) recorded *Polygnathus nothoperbonus* from the Warroo Limestone Member, further confirming the assignment of this limestone to the medial Emsian *Polygnathus perbonus* Conodont Zone. However, Basden et al. (2002) concluded that the Warroo Limestone should be correlated with the *Polygnathus inversus* to *P. serotinus* Conodont Zones. On balance the co-occurrence of *P. nothoperbonus* in both areas of NSW seems to indicate unequivocally a medial Emsian age for the macrofaunas. This supports the conclusions of Garratt and Wright (1988:Fig. 3), who correlated their *Malurostrophia-Taemostrophia-Howittia* fauna (essentially the shelly fauna discussed here) with the *Polygnathus gronbergi* (=*P. perbonus*) Conodont Zone.

Faunal characters and affinities

The fossiliferous limestones have yielded very rich and well-preserved invertebrate faunas, dominated by brachiopods, tabulate corals and tetracorals, trilobites, gastropods, ostracodes, cephalopods, tentaculitids, crinoid debris and sponges; bivalves are subordinate at this locality. Most of the trilobites and brachiopods at Brogans Creek are conspecific with those described from Emsian limestones in the Lake Burrinjuck sequence at Taemas and 'Bloomfield' by Chatterton (1971, 1973). With respect to the trilobites, the faunal composition of the Brogans Creek assemblage is best matched in the lower half of the Receptaculites Limestone at Locality Γ of Chatterton (1971). The three species identified here, *Proetus nemus*, *Dentaloscutellum hudsoni* and *Acanthopyge bifida*, are represented in the lower Receptaculites Limestone at Locality Γ and at that locality as well as Brogans Creek they occur with *Sthenarocalymene*. Silicified residues from Brogans Creek yield the following for minimal number of individuals per species, based on the most abundant skeletal element: *Proetus nemus* (N=54), *Dentaloscutellum hudsoni* (N=16), *Acanthopyge bifida* (N=7), and *Sthenarocalymene* sp. (N=2). About 120 kilograms of limestone have been etched to produce our fauna.

In terms of diversity, the silicified assemblage consists additionally of more than 15 brachiopod species (*Malurostrophia flabellicauda reverta* Chatterton; *Salopina kemezysi* Chatterton and other dalmanellids; *Schuchertella murphyi* Chatterton; *Coelospira dayi* Chatterton; *Howellella* sp.; *Ambothyris runnegari* Chatterton; *Howittia* sp.; ?*Buchanathyris* sp.; reticulariid indet.; *Cydimia parva* Chatterton; *Parachonetes flemingi* Chatterton; *P.* sp. cf. *P. konincki* Chatterton; rhynchonellids). Some 30 gastropod species are under study by Dr A.G. Cook. Tetracoral species are dominated numerically by an abundant solitary *Plasmophyllum*, as well as other solitary corals (?acanthophyllids) and rare fragments of ?*Calceola*. The sponge *Amphipora* is locally abundant, and presumably represents lagoonal phases of deposition or influx of lagoonal debris; several biofacies are evident. Colquhoun (1998) indicated that the Brogans Creek limestone was deposited in a well-oxygenated, normal salinity environment. The trilobite material is represented by disarticulated sclerites, but many brachiopods shells are articulated. Scolecodonts are at least as common as conodonts in residues; this is also a feature of limestones in the Capertee Valley (S of Brogans Creek) where the strata are highly deformed and preservation is poor. Despite the disarticulated nature of parts of the Brogans Creek shelly fauna, their excellent preservation indicates that postmortem transportation was minimal.

SYSTEMATIC PALAEONTOLOGY

Figured material is in the Palaeontology collection, Australian Museum, Sydney (prefix AMF).

Order PROETIDA Fortey and Owens, 1975
Family PROETIDAE Salter, 1864
Subfamily PROETINAE Salter, 1864
Genus PROETUS Steininger, 1831

Type species
Calymmene concinna Dalman, 1827; by original designation.

Proetus nemus Chatterton, 1971
Fig. 2a-p, Fig. 3a-t

Proetus nemus Chatterton, 1971:65-67, Pl. 16, Figs 18-32.
Ryckholtia? *nemus* (Chatterton). Lütke, 1990:21.

Material
39 cranidia, 103 librigenae, 3 hypostomes, 62 thoracic segments, 50 pygidia.

Diagnosis
Proetus with relatively elongate, tapering glabella, its posterior two thirds with dense, mostly moderate sized tubercles, its anterior third granulate. Facial suture divergent between γ and β. Genal ridge strong along

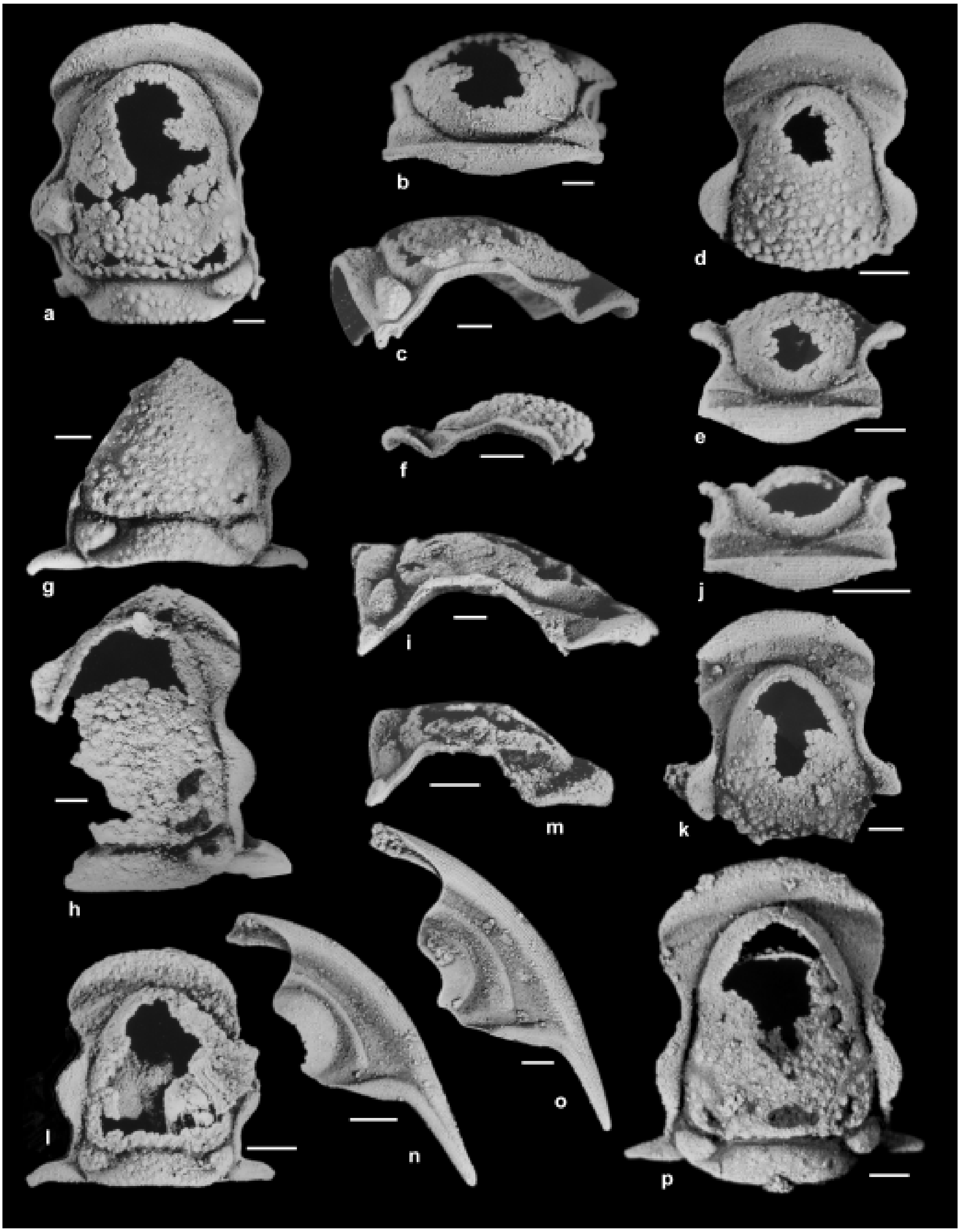

Figure 2. *Proetus nemus* Chatterton, 1971. Carwell Creek Formation (medial Emsian), Brogans Creek, NSW. Scale bars 1 mm. a-c, AMF 124700, cranidium, dorsal, anterior and lateral views; d-f, AMF 124701, cranidium, dorsal, anterior and lateral views; g, AMF 124702, cranidium, dorsal view; h, AMF 124703, cranidium, dorsal view; i, AMF 124704, cranidium, lateral view; j, AMF 124705, cranidium, anterior view; k, AMF 124706, cranidium, dorsal view; l-m, AMF 124707, cranidium, dorsal and lateral views; n, AMF 124708, librigena, dorsal view; o, AMF 124709, librigena, dorsal view; p, AMF 125485, cranidium, dorsal view.

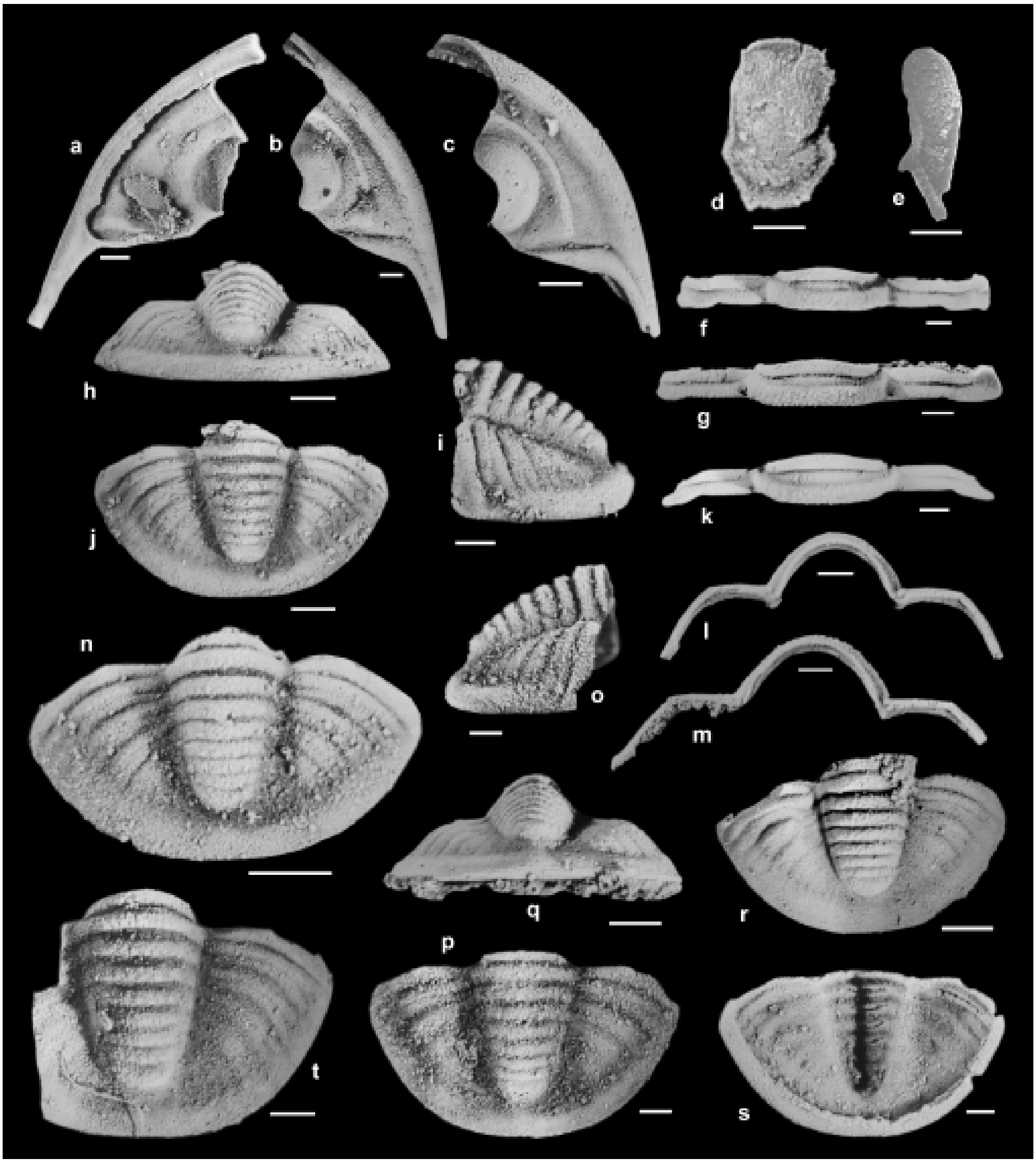

Figure 3. ***Proetus nemus*** **Chatterton, 1971. Carwell Creek Formation (medial Emsian), Brogans Creek, NSW. Scale bars 1 mm. a, AMF 124710, librigena, internal view; b, AMF 124711, librigena, dorsal view; c, AMF 124712, librigena, dorsal view; d-e, AMF 124713, hypostome, ventral and lateral views; f, AMF 124714, thoracic segment, dorsal view; g, AMF 124715, thoracic segment, dorsal view; h-j, AMF 124716, pygidium, posterior, lateral and dorsal views; k, AMF 124717, thoracic segment, dorsal view; l, AMF 124718, thoracic segment, anterior view; m, AMF 124719, thoracic segment, anterior view; n, AMF 124720, pygidium, dorsal view; o-p, AMF 124721, pygidium, lateral and dorsal views; q-r, AMF 124722, pygidium, posterior and dorsal views; s, AMF 124723, pygidium, ventral view; t, AMF 124724, pygidium, dorsal view.**

all but posteriormost part of librigenal field, distinct but less prominent on preocular fixigena; small caecal pits abundant on librigenal field; genal spine relatively long. Pygidium with seven axial rings and lunate terminal piece (7+1); anterior three or four pleural furrows well impressed, fifth and sixth faint.

Description

Cranidial length about equal to maximum width at ω; width at δ slightly more than 80% width at ω; width at β 85-95% width at δ. Axial furrow narrow, moderately, evenly deep. Glabella widest basally, length (excluding L0) 1.1-1.2 times basal width, with moderate taper anteriorly, slightly constricted at S2, gently convex (sag., tr.); frontal lobe rounded; terminating at but not overhanging anterior border furrow. S1 originating opposite midlength of palpebral lobe, shallow, directed posteromedially, distally birfucate, with posterior branch terminating well in front of S0; S2 parallel with S1, more weakly incised, originating just behind anterior edge of palpebral lobe; S3 obscure. Posterior two thirds of glabella with mostly moderate sized tubercles, some small tubercles, densely packed so as to nearly touch; anterior third of glabella granulate, non-tuberculate. S0 transverse medially, narrow (sag., exsag.), deep, flexed forwards abaxially against lateral occipital lobes. L0 distinctly wider than basal part of glabella, length about 20% its width; lateral occipital lobes large, drop-shaped, isolated from remainder of L0 by deep furrows; L0, including lateral lobes, covered with tubercles as on posterior part of glabella, including moderately large median tubercle behind midlength. Preglabellar region 13-15% of cranidial length; in large specimens, composed of an inclined, medially flat posterior half and moderately convex (sag.) anterior half bearing 5-6 terrace lines in dorsal view; in small specimens, posterior half forms a wide (sag., tr.) depressed field with a broad (tr.), gently inflated transverse median swelling. Genal ridge well developed on preocular fixigena, anteromedially directed, terminating at juncture of preglabellar and anterior border furrows, stronger in small specimens. Postocular fixigena 25-35% width (tr.) and about 60% length (exsag.) of L0. Palpebral lobe arcuate, 35-45% length of glabella; palpebral furrow faint or indistinct. Anterior sections of facial suture diverging from each other at 45-62° between γ and β, running subparallel against anterior border furrow, then strongly converging between β and α. Posterior sections of facial suture running subparallel or gently diverging between ε and ξ, close to axial furrow, then sharply turned outwards to ω.

Librigenal field moderately wide, gently convex (tr.); genal ridge strong along all but posteriormost part of field, closer to eye socle than to lateral border furrow; most of field with abundant, small caecal pits, least distinct at posterolateral corner of field. Eye socle narrow, separated from visual surface and librigenal field by shallow furrows. Posterior border furrow narrow, deep; lateral border furrow wider, the two merging at genal angle, extending along a variable extent of the genal spine, usually along about half its length. Lateral border 70-80% as wide as narrowest part of librigenal field in dorsal view, strongly convex (tr.); terrace lines well defined along entire length and width of lateral border and along genal spine. Genal spine relatively long, its inner margin straight or faintly concave. Panderian notch large, semicircular. Connective suture with straight, diagonal course along most of its length, its extent relative to cranidium indicating that rostral plate is trapezoidal or triangular, fairly wide anteriorly (cf. *P. concinnus*: Owens 1973:Text-fig. 1B).

Hypostomal width across shoulders about 65% sagittal length. Anterior margin weakly convex medially, flexed backward abaxially. Anterior lobe of middle body strongly inflated (tr.), anteromedial part raised but not forming discrete rhynchos; middle body gently convex (sag.) along most of length, fairly steeply turned up anteromedially; anterior lobe bearing many sinuous terrace lines. Middle furrow moderately deep, directed posterolaterally across abaxial third of middle body then abruptly effacing. Border furrow narrow, distinctly impressed around entire middle body, shallowest against anterior wing. Anterior border uniformly narrow (sag., exsag.); lateral border gently converging between anterior wing and shoulder; shoulder rounded; posterolateral margin straight between shoulder and pair of blunt spines at lateral edge of posterior border; posterior border narrow (sag., exsag.), about 10% length of hypostome, with gently convex posteromedian margin.

Number of thoracic segments unknown. Axial furrow narrow, shallow. Axis strongly convex (tr.), 32-41% width of thorax. Articulating half ring varying from equal in width (sag.) to 1.6 times as wide as preannulus along length of thorax, 70-90% length of ring; preannular furrow transverse to gently concave medially, sharply impressed but much shallower than articulating furrow; ring covered with small, dense tubercles or coarse granules. Pleural furrow narrow, about as deep as articulating furrow, gently flexed forward at fulcrum, abruptly shallowing then effacing on inner part of articulating facet; anterior and posterior pleural bands equal in width (exsag.) proximal to fulcrum; pleurae moderately declined abaxial to fulcrum, at midwidth (tr.) of rib. Pleural tips with curved anterolateral margin, blunt rounded posterior projection. Panderian notch deep, U-shaped.

Pygidium subsemicircular, length (excluding articulating half ring) 55-60% width. Axial width about 35% pygidial width anteriorly; axial furrows narrow, uniformly impressed along most of length. Seven axial rings and short, lunate terminal piece (7+1); first one or two ring furrows lengthened medially as short preannulus; more posterior ring furrows shallower but with moderately deep incision across axis, posterior few gently convex backwards; axis raised strongly above pleurae, gently convex in sagittal profile, moderately arched (tr.); rings with dense small tubercles or coarse granules. Postaxial region about 20% length of pygidium. Pleural furrows narrow (exsag.), anteriorly convex, anterior three or four well impressed, fifth and variably sixth faintly discernible; first pleural furrow terminates near pygidial lateral margin, others terminate at shallow posterior border furrow; interpleural furrows narrower and shallower than pleural furrows; pleural ribs with sculpture of dense, medium sized granules. Border widening back to its intersection with third pleural furrow, then maintaining even width, occupying most of postaxial region, weakly convex. Doublure extending in nearly as far as border furrow, bearing several terrace lines.

Discussion

The sample from Brogans Creek resembles that from Taemas in that the largest cranidia (Fig. 2a-c, h, i, p; Chatterton 1971:Pl. 16, fig. 28) have the anterior end of the glabella abutting the inclined posterior part of the anterior border, whereas small specimens have a broad depression between the frontal lobe and the convex, terraced part of the anterior border (Fig. 2d-f, j, k; Chatterton 1971:Pl. 16, fig. 25). The latter morphology, associated with a more pronounced fixigenal ridge (Fig. 2d, k versus 2a, h, p) is confined to small specimens. This difference in the preglabellar region is bridged by intermediate sized specimens, and is ascribed to ontogenetic variation. The transverse median swelling in the depression of small specimens (Fig. 2e, j) retains a faint expression in large cranidia. No bimodality can be detected in the strength of the librigenal ridge (Figs. 2n, o, 3b, c), which is consistently pronounced.

In assigning this species to *Proetus*, Chatterton (1971) acknowledged its distance from the type species, the Wenlock *P. concinnus* (Dalman). However, several other Australian Emsian and Eifelian Proetinae are validly assigned to that genus. These include *Proetus talenti* Chatterton, 1971 (type of *Devonoproetus* Lütke, 1990), *P. sparsinodosus* Feist and Talent, 2000, and *P. latimargo* Feist and Talent, 2000, the latter two originally assigned to *Devonoproetus* at the subgeneric level. *Devonoproetus* is a junior synonym of *Proetus* s.s. (Adrain 1997; Zhou et al. 2000).

Proetus nemus was reassigned, with question, to the otherwise Ludlow-Lochkovian *Ryckholtia* Šnajdr, 1980 (type *Proetus ryckholti* Barrande, 1846) by Lütke (1990). The new material described herein conflicts with this reassignment. Membership in *Ryckholtia* is precluded by the pronounced tuberculate sculpture on the glabella and axial rings of *P. nemus*, the strongly defined lateral occipital lobes, and sagittal elimination of the preglabellar field.

This species displays characters that suggest alternative assignments. The elongate, tapering glabella of *Proetus nemus* and its pattern of sculpture (strong tuberculation posteriorly, becoming subdued anteriorly), together with the profile of the preglabellar region, including the wide (sag., exsag.) anterior cranidial border furrow, and the divergence of the facial suture between γ and β resemble *Longiproetus tenuimargo* (Richter, 1909) (type of *Longiproetus* Cavet and Pillet, 1958). *Longiproetus* has been regarded as a synonym of *Gerastos* Goldfuss, 1843 (Owens 1973), a valid subgenus of *Gerastos* (Šnajdr 1980), restricted to its type species on the basis of a distinctive shape of the rostral plate (Lütke 1990), or slightly expanded to include a small group of Rhenohercynian mid Eifelian to early Givetian species (Basse 1996, 2002). Lütke (1990) reassigned the Bohemian species that had been referred to *Longiproetus* (e.g., Šnajdr 1980) to *Coniproetus* Alberti, 1966, and other genera, whilst the inadequately known Emsian species referred to *Longiproetus* by Pillet (1972) defy classification. Despite the similarities in the glabella and preglabellar region, several characters conflict with an alliance between *P. nemus* and *Longiproetus*. Notably, the strong genal ridge of *P. nemus* is lacking in *L. tenuimargo* and other certain congeners (*sensu* Basse 2002), the prominent lateral occipital lobes contrast with the inconspicuous lobes in *Longiproetus* s.s., L0 is wider than the basal part of the glabella, the cephalon is much less vaulted, the palpebral lobe is situated more posteriorly, and the pygidium is relatively paucisegmented (7+1 rings versus 8+1). The course of well preserved connective sutures on librigenae suggests that the rostral plate of *P. nemus* is more regularly trapezoidal or triangular than is that of *L. tenuimargo* (Lütke 1990:Text-fig. 8).

Affinities to species that have been assigned to *Devonoproetus* by recent workers better account for the large occipital lobes, width of L0 relative to the glabella, and 7+1 pygidial segmentation. Among these, *Proetus latimargo* Feist and Talent, 2000 (Eifelian, Queensland) and *P. zhusilengensis* Zhou et al., 2000

(Emsian, Inner Mongolia) resemble *P. nemus* in having a tongue-shaped glabella (narrowest in *P. nemus*) with dense, pronounced tuberculation, and *P. latimargo* shares the divergence of the facial suture between α and β.

Among those species that have been referred to *Devonoproetus*, the strong genal ridge of *Proetus nemus* is developed in a group recognised by Basse (2002) as a separate genus, *Rhenocynproetus*, from which the Australian "*Devonoproetus*" species were explicitly excluded. The presence of a genal ridge in other genera of Proetinae [e.g. *Gerastos*: Šnajdr 1980:Pl. 3, Fig. 13, Pl. 4, Fig. 17; *Coniproetus* (*Bohemiproetus*): Šnajdr 1980:Pl. 6, Figs 5, 6, 14; Lieberman 1994:Fig. 9.3) demonstrates that this feature is not an infallible indicator of relationships. Characters cited by Basse (2002) as excluding Australian species of *Proetus* from *Rhenocynproetus* also distinguish *P. nemus*; these include the large size of the lateral occipital lobes and weaker outer edge of the eye socle. *Proetus nemus* possesses (plesiomorphic) features considered by Basse (2002) to more generally distingish *Proetus* from *Rhenocynproetus*, such as a less inflated glabella, the lateral occipital lobes wider than the base of the glabella, terrace lines developed on the dorsal as well as lateral extent of the cranidial border, and the well developed librigenal spine. The presence of a pair of posterior border spines on the hypostome (Fig. 3d) is shared with *Proetus* (e.g. Whittington and Campbell 1967:Pl. 1, Fig. 17; Schrank 1972:Pl. 4, Fig. 7), including *P. talenti*, but is likely symplesiomorphic (Adrain 1997).

Order CORYNEXOCHIDA Kobayashi, 1935
Suborder SCUTELLUINA Hupé, 1953
Family STYGINIDAE Vogdes, 1890
Genus DENTALOSCUTELLUM Chatterton, 1971

Type species
Dentaloscutellum hudsoni Chatterton, 1971; by original designation.

Dentaloscutellum hudsoni Chatterton, 1971
Fig. 4a-i

Dentaloscutellum hudsoni Chatterton, 1971:12-22, Pl. 1, Figs 1-24, Pl. 2, Figs 1-24, Pl. 3, Figs 1-12, Pl. 24, Fig. 15, Text-figs 4-5.

Material
4 cranidia, 29 librigenae, 1 hypostome, 1 thoracic segment, 5 fragmentary pygidial margins.

Discussion
This species was fully described based on specimens from the Receptaculites Limestone near Taemas (Chatterton 1971). The Brogans Creek material is considered to be conspecific, the only possible difference being slightly more numerous cranidial tubercles (Fig. 4b, c) than in the type material.

Order LICHIDA Moore, 1959
Family LICHIDAE Hawle and Corda, 1847
Subfamily TROCHURINAE Phleger, 1936
Genus ACANTHOPYGE Hawle and Corda, 1847

Type species
Acanthopyge leuchtenbergii Hawle and Corda, 1847; by subsequent designation of Reed (1902).

Subgenus JASPERIA Thomas and Holloway, 1988

Type species
Acanthopyge (Mephiarges) *bifida* Edgell, 1955; by original designation.

Acanthopyge (Jasperia) *bifida* Edgell, 1955
Fig. 4j-t

Acanthopyge (Mephiarges) *bifida* Edgell, 1955:138; Chatterton, 1971:30-41, Pl. 6, Figs 1-24, Pl. 7, Figs 1-27, Pl. 8, Figs 1-17, Text-figs 8-10.

Material
7 cranidia, 1 rostral plate, 7 librigenae, 3 hypostomes, 1 thoracic segment, 2 pygidia.

Discussion
The Brogans Creek specimens are indistinguishable from those described from Wee Jasper (Edgell 1955) and Taemas (Chatterton 1971). The species was fully described by Chatterton (1971), rendering description of the Brogans Creek material unnecessary. A few specimens are illustrated (Fig. 4j-t) in support of the conspecificity of the collections.

Order PHACOPIDA Salter, 1864
Suborder CALYMENINA Swinnerton, 1915
Family CALYMENIDAE Milne Edwards, 1840
Genus STHENAROCALYMENE Siveter, 1977

Type species
Sthenarocalymene lirella Siveter, 1977; by original designation.

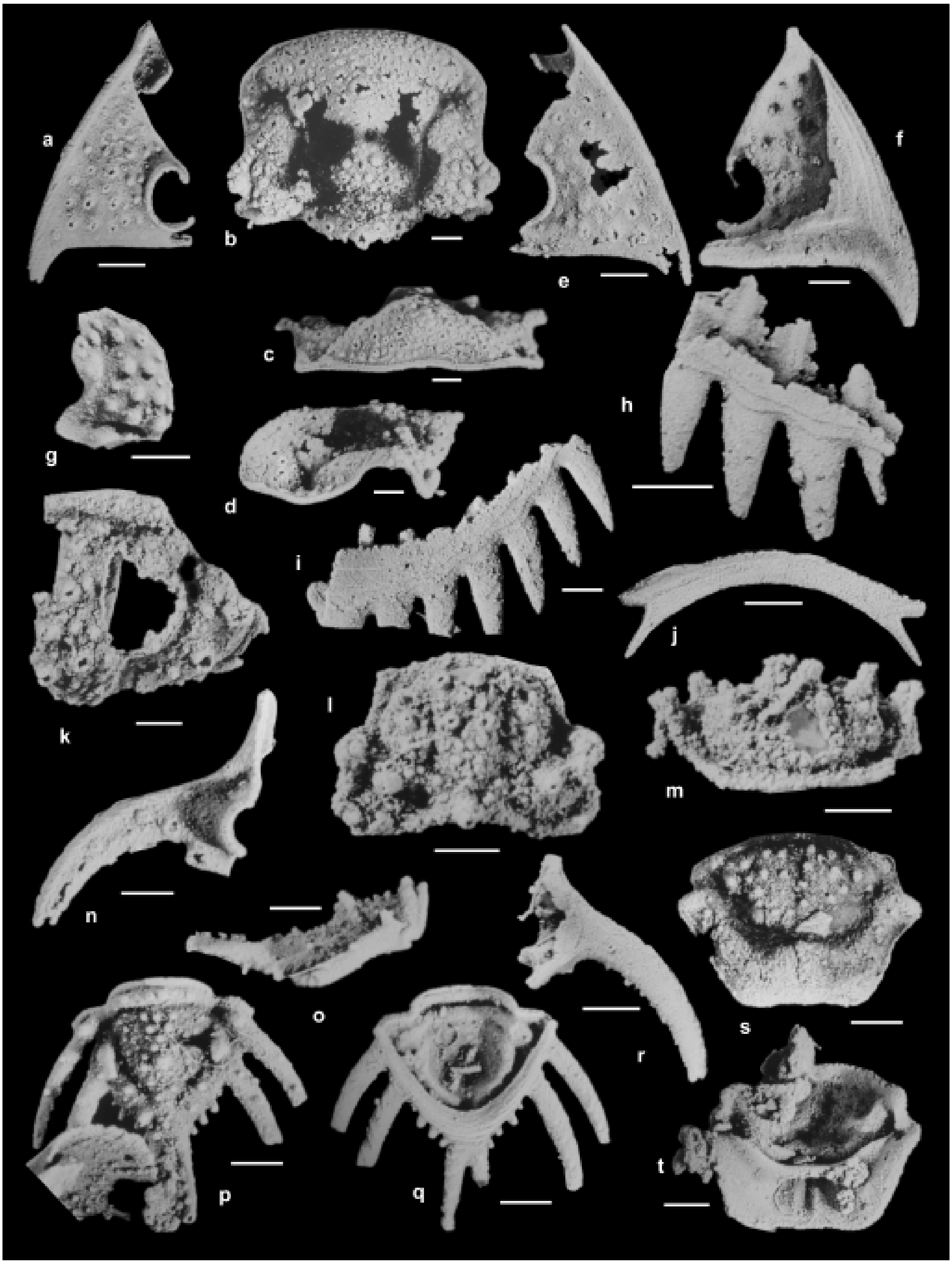

Figure 4. a-i, *Dentaloscutellum hudsoni* Chatterton, 1971. Scale bars 1mm. a, AMF 124725, librigena, dorsal view; b-d, AMF 124726, cranidium, dorsal, anterior and lateral views; e, AMF 124727, librigena, dorsal view; f, AMF 124728, librigena, ventral view; g, AMF 124729, fixigena, dorsal view; h, AMF 124730, incomplete pygidium, ventral view; i, AMF 124731, incomplete pygidium, ventral view. j-t, *Acanthopyge (Jasperia) bifida* Edgell, 1955. Scale bars 1 mm. j, AMF 124732, rostral plate, ventral view; k, AMF 124733, cranidium, dorsal view; l-m, AMF 124734, cranidium, dorsal and anterior views; n, AMF 124735, librigena, dorsal view; o-q, AMF 124736, pygidium, lateral, dorsal and ventral views; r, AMF 124737, librigena, ventral view; s-t, AMF 124738, hypostome, ventral and dorsal views.

Sthenarocalymene sp.

Material
Two cranidial fragments, one fragmentary librigena.

Discussion
A few calymenid cephalic fragments indicate the presence of a species lacking a buttress between the fixigena and L2. On this basis the material is assigned to *Sthenarocalymene*, the non-buttressed calymenid in many Australian Lower Devonian faunas [see Sandford (2000) for discussion of this genus, its synonym *Apocalymene* Chatterton and Campbell, 1980, and *Gravicalymene* Shirley, 1936]. The Brogans Creek material may be identical with *S. quadrilobata* (Chatterton, 1971), which co-occurs with the other taxa described herein in the lower Receptaculites Limestone at Locality Γ of Chatterton (1971), but specific identity requires better specimens.

ACKNOWLEDGEMENTS

Alex Cook (Queensland Museum) assisted AJW in the field, and processed and picked much of the material studied here. Yongyi Zhen (Australian Museum) photographed the specimens and assembled the plates, and processed several blocks of limestone. Robert Owens (National Museum of Wales) provided helpful suggestions on an earlier version of the mansucript.

REFERENCES

Adrain, J.M. (1997). Proetid trilobites from the Silurian (Wenlock-Ludlow) of the Cape Phillips Formation, Canadian Arctic Archipelago. *Palaeontographia Italica* **84**, 21-111.

Alberti, G.K.B. (1966). Über einige neue Trilobiten aus dem Silurium und Devon, besonders von Marokko. *Senckenbergiana lethaea* **47**, 111-121.

Barrande, J. (1846). 'Notice préliminaire sur le système Silurien et les Trilobites de Bohême'. (Leipzig).

Basden, A., Burrow, C., Hocking, M., Parkes, R. and Young, G. (2002). Siluro-Devonian microvertebrates from southeastern Australia. *Courier Forschungsinstitut Senckenberg* **223**, 201-222.

Basse, M. (1996). Trilobiten aus mittelerem Devon des Rhenohercynikums: I. Corynexochida und Proetida (1). *Palaeontographica A* **239**, 89-182.

Basse, M. (2002). 'Eifel-Trilobiten. 1. Proetida'. (Goldschneck-Verlag: Korb).

Campbell, K.S.W. and Talent, J.A. (1963). *Malurostrophia*, a new genus of stropheodontid brachiopod from the Devonian of Australia. *Proceedings of the Royal Society of Victoria* **80**, 309-330.

Carne, J.E. and Jones, L.J. (1919). The limestone deposits of New South Wales. *Geological Survey of New South Wales, Mineral Resources* **25**, 1-411.

Cavet, P. and Pillet, J. (1958). Les trilobites du calcaires à Polypiers silicieux (Eifelien) du Synclinal de Villefranche-de-Confluent (Pyrenées Orientales). *Bulletin de la Société géologique de France* **81**, 21-37.

Chatterton, B.D.E. (1971). Taxonomy and ontogeny of Siluro-Devonian trilobites from near Yass, New South Wales. *Palaeontographica A* **137**, 1-108.

Chatterton, B.D.E. (1973). Brachiopods of the Murrumbidgee Group, Taemas, New South Wales. *Bulletin of the Bureau of Mineral Resources, Geology and Geophysics (Australia)* **137**, 1-146.

Chatterton, B.D.E. and Campbell, K.S.W. (1980). Silurian trilobites from near Canberra and some related forms from the Yass Basin. *Palaeontographica A* **167**, 77-119.

Colquhoun, G.P. (1995). Early Devonian conodonts from the Capertee High, E Lachlan Fold Belt, southeastern Australia. *Courier Forschungsinstitut Senckenberg* **182**, 347-369.

Colquhoun, G.P. (1998). Early Devonian stratigraphy, conodont faunas and palaeogeography of the Capertee High. PhD thesis, University of Wollongong.

Colquhoun, G.P., Meakin, N.S. and Watkins, J.J. (1999). Kandos Group. In 'Dubbo 1:250 000 Geological Sheet, 2nd edition. Explanatory Notes' (Eds N.S. Meakin and E.J. Morgan) pp. 125-143. (Geological Survey of New South Wales: Sydney).

Dalman, J.W. (1827). Om Palaeaderna eller de så kallade Trilobiterna. *Kungliga Svenska Vetenskapsakademiens Handlingar* **1826**, 113-152, 226-294.

Edgell, H.S. (1955). A Middle Devonian lichid trilobite from South-Eastern Australia. *Paläontologische Zeitschrift* **29**, 136-145.

Feist, R. and Talent, J.A. (2000). Devonian trilobites from the Broken River region of northeastern Australia. *Records of the Western Australian Museum, Supplement* **58**, 65-80.

Fortey, R.A. and Owens, R.M. (1975). Proetida – a new order of trilobites. *Fossils and Strata* **4**, 227-239.

Garratt, M.J. and Wright, A.J. (1988). Late Silurian to Early Devonian biostratigraphy of southeastern Australia. In 'Devonian of the World. Volume III: Paleontology, Paleoecology and Biostratigraphy' (Eds N.J. McMillan, A.F. Embry, Jr., and D.J. Glass) pp. 647-662. (Canadian Society of Petroleum Geologists: Calgary).

Goldfuss, A. (1843). Systematische Übersicht der Trilobiten und Beschreibung einiger neuen Arten

derselben. *Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde* **1843**, 537-567.
Hawle, I. and Corda, A.J.C. (1847). Prodrom einer Monographie der böhmischen Trilobiten. *Böhmischen Gesellschaft der Wissenschaften, Abhandlungen* **5**, 1-176.
Hupé, P. (1953). Classe des Trilobites. In 'Traité de Paléontologie. Volume 3' (Ed J. Piveteau) pp. 44-246. (Masson: Paris).
Kobayashi, T. (1935). The Cambro-Ordovician Formations and Faunas of South Chosen. Palaeontology. Part III. *Journal of the Faculty of Science, Tokyo University* **4**, 49-344.
Lieberman, B.S. (1994). Evolution of the trilobite subfamily Proetinae Salter, 1864, and the origin, diversification, evolutionary affinity, and extinction of the Middle Devonian proetid fauna of eastern North America. *Bulletin of the American Museum of Natural History* **223**, 1-176.
Lindley, I.D. (2002). Acanthodian, onychodontid and osteolepid fish from the middle-upper Taemas Limestone (Early Devonian), Lake Burrinjuck, New South Wales. *Alcheringa* **26**, 103-126.
Lishmund, S.R., Dawood, A.D. and Langley, W.V. (1986). The limestone deposits of New South Wales, 2nd edition. *Geological Survey of New South Wales, Mineral Resources* **25**, 1-373.
Lütke, F. (1990). Contributions to a phylogenetical classification of the subfamily Proetinae SALTER, 1864 (Trilobita). *Senckenbergiana lethaea* **71**, 1-83.
Mawson, R. (1987). Early Devonian conodont faunas from Buchan and Bindi, Victoria. *Palaeontology* **30**, 251-297.
Meakin, N.S. and Morgan, E.J. (1999). 'Dubbo 1:250 000 Geological Sheet, 2nd edition. Explanatory Notes'. (Geological Survey of New South Wales: Sydney).
Milne Edwards, H. (1840). 'Histoire Naturelle des Crustacés, Comprenant l'Anatomie, la Physiologie et la Classification de ces Animaux, 3'. (Roret: Paris).
Moore, R.C. (1959). Order Lichida. In 'Treatise on Invertebrate Paleontology. Part O. Arthropoda 1' (Ed R.C. Moore) p. O495. (Geological Society of America, University of Kansas Press: Lawrence).
Owens, R.M. (1973). British Ordovician and Silurian Proetidae (Trilobita). *Palaeontographical Society Monograph*, 1-98.
Pedder, A.E.H., Jackson, J.H. and Philip, G.M. (1970). Lower Devonian biostratigraphy in the Wee Jasper region of New South Wales. *Journal of Paleontology* **44**, 206-251.
Phleger, F.B. (1936). Lichadian trilobites. *Journal of Paleontology* **10**, 593-615.
Pickett, J.W. (1972). Correlation of the Middle Devonian formations of Australia. *Geological Society of Australia* 18, 457-466.
Pickett, J.W. (1978). Conodont faunas from the Mount Frome Limestone (Emsian-Eifelian). *Bulletin of the Bureau of Mineral Resources, Geology and Geophysics (Australia)* **192**, 97-107.
Pillet, J. (1972). Les trilobites du Dévonien inférieur et du Dévonien moyen du Sud-Est du Massif Armoricain. *Mémoires Société d'Etudes scientifiques de l'Anjou* **1**, 1-307.
Reed, F.R.C. (1902). Notes on the genus *Lichas*. *Journal of the Geological Society of London* **58**, 59-82.
Richter, R. (1909). Beiträge zur Kenntnis devonischer Trilobiten aus dem Rheinischen Schiefergebirge. Vorbericht zu einer Monographie der Trilobiten der Eifel. Dissertation, Marburg.
Salter, J.W. (1864). A monograph of the British trilobites from the Cambrian, Silurian, and Devonian formations. *Monographs of the Palaeontographical Society*, 1-80.
Sandford, A.C. (2000). Trilobite faunas and palaeoenvironmental setting of the Silurian (early Ludlow) Melbourne Formation, central Victoria. *Alcheringa* **24**, 153-206.
Schrank, E. (1972). Proetacea, Encrinuridae und Phacopina (Trilobita) aus silurischen Geschieben. *Geologie* **76**, 1-117.
Shirley, J. (1936). Some British trilobites of the family Calymenidae. *Quarterly Journal of the Geological Society of London* **92**, 384-421.
Siveter, D.J. (1977). The Middle Ordovician of the Oslo region, Norway, 27. Trilobites of the family Calymenidae. *Norsk Geologisk Tidsskrift* **56**, 335-396.
Šnajdr, M. (1980). Bohemian Silurian and Devonian Proetidae (Trilobita). *Rozpravy Ústredniho ústavu geologického* **45**, 1-324.
Steininger, J. (1831). 'Bemerkungen über die Versteinerungen, welche in dem ÜbergangsKalkgebirge der Eifel gefunden werden'. (Eine Beilage zum Gymnasial-Program zu Trier: Trier).
Swinnerton H.H. (1915). Suggestions for a revised classification of trilobites. *Geological Magazine, New Series* **2**, 407-496, 538-545.
Talent, J.A., Mawson, R. and Simpson, A.J. (2000). Silurian to Early Carboniferous (Tournaisian) platform-slope sequences in eastern Australia: recent advances in stratigraphic alignments. *Geological Society of Australia, Abstracts* **61**, 114-120.
Thomas, A.T. and Holloway, D.J. (1988). Classification and phylogeny of the trilobite order Lichida. *Philosophical Transactions of the Royal Society of London* **32**, 179-262.
Vogdes, A.W. (1890). A bibliography of Paleozoic Crustacea from 1698 to 1890 including a list of North American species and a systematic arrangement of genera. *Bulletin of the United States Geological Survey* **63**, 1-177.

Whittington H.B. and Campbell, K.S.W. (1967). Silicified Silurian trilobites from Maine. *Bulletin of the Museum of Comparative Zoology* **135**, 447-483.
Zhou Z.-q., Siveter, D.J. and Owens, R.M. (2000). Devonian proetid trilobites from Inner Mongolia. *Senckenbergiana lethaea* **79**, 459-499.