THE AUSTRALIAN NATIONAL UNIVERSITY

BIOSTRATIGRAPHY AND TAXONOMY OF LOWER CRETACEOUS MOLLUSCAN FAUNAS FROM THE QUEENSLAND PORTION OF THE GREAT ARTESIAN BASIN

by

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Class CEPHALOPODA Cuvier, 1797

Subclass NAUTILOIDEA Agassiz, 1847

Order NAUTILIDA Agassiz, 1847

Superfamily NAUTILACEAE de Blainville, 1825

Family Nautilidae de Blainville, 1825

Remarks: This family comprises involute or slightly evolute conchs that are generally smooth, with compressed to depressed whorl sections, and sutures that are straight to sinuous.

Kummel (1964) included in the family the genera *Nautilus* Linne, *Carinonautilus* Spengler, *Obinautilus* Kobayashi, *Strionautilus* Shimansky, *Cenoceras* Hyatt, *Pseudocenoceras* Spath and *Eutrephoceras* Hyatt. All except *Strionautilus* were fully discussed by Kummel (1956), who catalogued the geographic and stratigraphic occurrences of the named species. The oldest member of the Nautilidae is a species of *Cenoceras* from the Upper Triassic of New Zealand. *Cenoceras* in the Jurassic, and *Eutrephoceras* in the Cretaceous and Tertiary were relatively abundant and worldwide in distribution. A relict of 5 species of *Nautilus* survives in the south western Pacific Ocean.

Genus *Eutrephoceras* Hyatt, 1894

Type species (by original designation): *Nautilus dekayi* Morton, 1834, Upper Cretaceous, U.S.A.

Generic diagnosis: Nautiliconic, generally subglobular. Whorl section reniform, broadly rounded ventrally and laterally. Aperture marked ventrally by a broad, shallow, rounded hyponomic sinus.

Umbilicus small to occluded. Surface smooth. Suture only slightly sinuous; annular lobe may be present. Siphuncle small, variable in position.

Range: Upper Jurassic - Miocene

Remarks: The morphology and relationships of the genus *Eutrephoceras* were described in detail by Kummel (1956, p. 377-384). He noted the occurrence of forms intermediate between *Eutrephoceras* and the hercoglossid *Cimomia* Conrad. *Eutrephoceras hendersoni* (Etheridge Jnr) described below is such an intermediate.

Eutrephoceras is a very common genus with a cosmopolitan distribution. Kummel (1956) listed 6 Jurassic, 39 Cretaceous, and 44 Tertiary species.

Eutrephoceras hendersoni (Etheridge Jnr), 1901

Pl.1, fig.1; pl.2, fig.1; pl.3, fig.4

Synonymy:

1892 *Nautilus hendersoni* Etheridge Jnr, p. 502.

1901 *Nautilus* (*Cymatoceras* ?) *hendersoni* Etheridge Jnr, p. 34, pl. 1, fig. 1-2; pl. 2, figs 1-3.

1905 *Nautilus* (*Cymatoceras* ?) *hendersoni* Etheridge Jnr, p. 16, pl. 1, figs 6-9; pl. 3, figs 9-12.

1952 *Eutrephoceras hendersoni* (Etheridge Jnr); Teichert, p. 737.

1956 *Eutrephoceras hendersoni* (Etheridge Jnr); Kummel, p. 382.

1958 *Cymatoceras hendersoni* (Etheridge Jnr); Glaessner, p. 211, text fig. 3a-c.

1966 *Eutrephoceras hendersoni* (Etheridge Jnr); Ludbrook, p. 190, pl. 28, figs 3-7.

Types: Lectotype: F1400 GSQ (specimen figured by Etheridge Jnr 1901, pl. 1, figs 1-2; pl. 2, fig. 1. Locality: "Maxwellton, near Hughenden", Allaru Mudstone, lower upper Albian.

Material: 6 specimens preserved mainly as internal moulds.

Specific diagnosis: Small to very large *Eutrephoceras* with a large, central siphuncle; suture slightly sinuous.

Description: Conch subglobular; small to very large, maximum diameter 75-300 mm; tightly involute. Whorl section reniform; broadly rounded ventrally and laterally. Venter with a wide, shallow hyponomic sinus. Aperture large. Siphuncle large, subcentral. Umbilicus small and deep. Septa moderately concave. Suture straight on the venter, slightly sinuous on the flanks, with a broad shallow lateral lobe and a narrow umbilical saddle. Ornament consisting of fine collabral growth lines and finer spiral lines.

Dimensions: (mm)	Maximum Diameter	Whorl Height	Whorl thickness
Lectotype F1400 GSQ	126	80	89
CPC 9485	100+	-	70+
CPC 9486	145	85	-
CPC 9487	240	150	-

Remarks: Three specimens from GAB836 and one from GAB2096 have only one half of the conch preserved. They may represent occurrences of dead shells which stranded in the manner outlined for *Nautilus* by Reyment (1958). If so, the preserved portion is the lower half which became filled with sediment, the upper half having been eroded subsequently.

Etheridge Jnr (1901, p. 35) in describing this species thought that it might be referrable to Cymatoceras Hyatt or Eutrephoceras Hyatt. Teichert (1952, p. 737) noted the absence of strong ribbing and suggested reference to Eutrephoceras.

The suture of the present specimens closely resembles that of New Guinean representatives of Eutrephoceras hendersoni figured by Glaessner (1958, p. 212, text fig. 3b-c). Its sinuosity approaches that of species of Cimonia Conrad. Species with sutures similarly intermediate between Eutrephoceras and Cinomia were previously noted by Kummel (1956, p. 377, p. 448, text fig. 32). According to that author Cimomia is morphologically transitional between Eutrephoceras and Hercoglossa, the nominal genus of the Hercoglossidae.

Occurrence:

Allaru Mudstone "Maxwellton,near Hughenden"; "Wellshot run, near Barcaldine"; "Ilfracombe" (Etheridge Jnr, 1901); GAB836; GAB1606; GAB2096. Tributary of Brutus Creek about 1 mile S.E. of "Currane" (grid ref. 260083 Longreach).

Maree Formation: "Dalhousie Springs" (Etheridge Jnr, 1905); Yardinna 5/550/1 (Ludbrook, 1966).

New Guinea - Glaessner (1958).

Age: Early late Albian

Subclass AMMONOIDEA Zittel, 1884

Order ANCYLOCERATIDA Wiedmann, 1966

Remarks: Casey (1960, p.12) concluded a brief review of the history of the classification of irregularly coiled ammonites (heteromorphs) with the statement "unless we are to introduce a new suborder to accommodate them, attachment to the Lytoceratina seems a permissible expedient. Wiedmann (1966) after a detailed review of the stratigraphic history of post-Triassic ammonites coupled with a close study of their suture patterns, separated the heteromorphs into a suborder Ancyloceratina. This taxon is adopted herein but is assigned ordinal rank.

Superfamily ANCYLOCERATACEAE Meek, 1876

Remarks: Wiedmann's (1962) concept of this superfamily is adopted here.

Family Ancyloceratidae Meek, 1876

Remarks: Members of this family are typically regularly coiled with early whorls in contact or separated (crioceratid coiling) and sometimes have a straight or hooked body chamber (ancyloceratid coiling). The whorl section ranges from circular to square and the ornament is usually not constant throughout growth. Ribbing varies from strong to weak, and periodic umbilical, lateral and ventro-lateral tubercles are commonly developed. The suture is complex with bifid saddles and trifid lobes.

Casey (1960, p.17) has fully discussed the morphology, content, and affinities of the family Ancyloceratidae. He recognises two subfamilies, Ancyloceratinae and Helicancylinae. The family is very widely distributed and ranges from the lower Hauterivian to the upper Aptian.

Subfamily Ancyloceratinae Meek, 1876

Remarks: As defined by Casey (1960, p.18) this subfamily comprises large heteromorphs with the body chamber commonly more coarsely ornamented than the early whorls. Casey included the genera Ancyloceras d'Orbigny, Tropaeum Sowerby, Australiceras Whitehouse, Epancyloceras Spath, Ammonitoceras Dumas, and Lithancylus Casey.

Casey (1960, p.19, text. fig.5) has shown that ancyloceratid coiled species of the subfamily occur stratigraphically below horizons with crioceratid coiled species, and that the progressive evolutionary trend within this group was towards incoiling.

The Ancyloceratinae had a worldwide distribution and are of considerable value in the intercontinental correlation of Aptian strata.

Genus Tropaeum J. de C. Sowerby, 1837

Type species (by monotypy): Tropaeum bowerbanki J. de C. Sowerby, 1837, lower Aptian (bowerbanki Zone), England.

Generic diagnosis: Large ancycloceratids with predominantly crioceratid coiling; first volutions irregular but coiled in one plane; in mid-life volutions form a regular spiral, often with the whorls in contact; this mode of coiling may persist to the ultimate whorl or the outer whorl may break free or be produced as a hook. Whorl section at first subrectangular, frequently modified to subcordate

TEXT FIG. 9

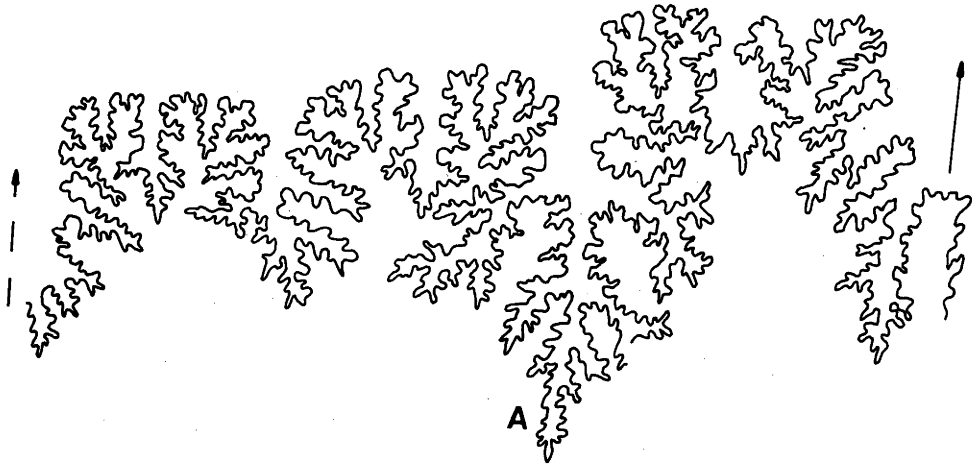
SUTURES OF ANCYLOCERATID AMMONITES

A *Australiceras irregulare* (Tenison Woods), F35624 UQ, suture at whorl height 58mm, X1; locality RD90, Doncaster Member, late Aptian.

B *Tropaeum leptum* (Etheridge Jnr), CPC9819, suture at whorl height 54mm, X1; locality GAB2163, same formation.

C *Australiceras irregulare* (Tenison Woods), CPC9259, suture at whorl height 20mm, X1; locality GAB1137, same formation.

D "*Toxoceratoides*" sp., F16762 CPC, suture at whorl height 18mm, X1; locality "Bungeworgorai Ck below Mt Abundance homestead", same formation.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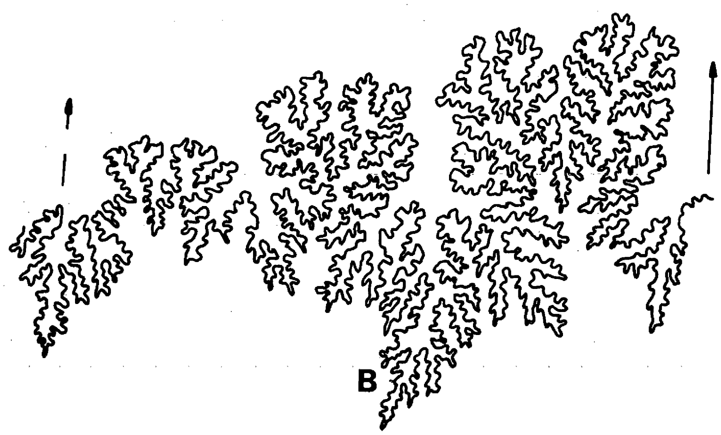
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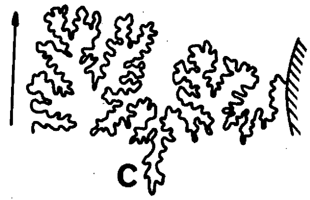
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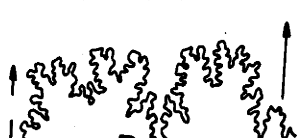

D

or dome-shaped in adult stage. Early whorls ornamented with dense, narrow, essentially non-tuberculate ribs; ornament commonly undergoes a sudden change on the body chamber to heavy, distantly spaced ribbing. Body chamber occupying half to two-thirds of whorl, sometimes sharply contracted aperturally. Suture line as in Ancyloceras.

Range: Aptian (deshayesi Zone to nutfieldensis Zone).

Remarks: The nomenclatorial history, morphology, affinities, and stratigraphic occurrences of Tropaeum were fully documented by Casey (1960, pp. 23-25) in his comprehensive study of that genus. Casey thought that there was good stratigraphic evidence for the evolution of Tropaeum from the ancyloceratid coiled group of Australiceras gigas by loss of tuberculation and progressive incoiling.

"Tropaeum is a characteristic Aptian genus, ranging from the deshayesi zone of the Lower Aptian to the nutfieldensis zone of the Upper Aptian" (Casey, 1960, p. 24). In Europe its geographic range is extensive and encompasses southern England, northern Germany, Caucasus and Transcaspia (Casey, 1960). Tropaeum is also found in Spitsbergen (Frebold, 1930), Eastern Greenland (Spath, 1946), Arctic Canada (Jeletzky, 1964), California (Anderson, 1938), Japan (Nakai, 1968),South Georgia (Wilckens, 1947), Patagonia (Leanza, 1963), Zululand (Haughton, 1936), Mozambique (da Silva, 1962), Madagascar (Collignon, 1962) as well as Australia. The Australian species of Tropaeum display closest affinities to those from Arctic Canada, Madagascar and southernmost South America.

Tropaeum undatum Whitehouse, 1926
Pl.24, fig.1; pl.26, figs 1-2; pl.27, fig.2; pl.28, figs 5-6

Synonymy:

1909 Crioceras jackii Etheridge Jnr, pl. 31, figs 1-2; pl. 32, fig. 2; pl. 34, fig. 1; pl. 38, figs 4-5.

1926 Tropaeum undatum Whitehouse, p. 215.

1926 Tropaeum arcticum (Stolley); Whitehouse, p. 215.

1926 Tropaeum rarum Whitehouse, p. 216, pl. 36, figs 1a-b.

1950 Australiceras jacki (Etheridge Jnr); David & Browne, pl. 44, fig. C.

1961 Tropaeum undatum Whitehouse; Woods, p. 3, 6.

cf.1964 Tropaeum undatum Whitehouse; Jeletzky, p. 68, pl. 20, fig.2.

1964 Tropaeum arcticum (Stolley); Day, p. 18.

Types: Tropaeum undatum Whitehouse. Holotype: F1264 QM. Locality: "Walsh River", Blackdown Formation, upper Aptian.

Tropaeum rarum Whitehouse. Holotype: F1598 QM. Locality: "Walsh River", Blackdown Formation, upper Aptian.

Material: Two well preserved specimens and several fragments.

Specific diagnosis: Generally medium sized Tropaeum with loose, crioceratid coiling; whorl section subquadrate; early whorls with strong, narrow, closely spaced, well elevated ribs, sometimes with incipient trituberculation; ribs on body chamber essentially similar, but thicker, and with slightly widely spacing.

Description: Generally medium sized, occasionally quite large. Coiling loose, crioceratid; whorls widely separated. Whorl section subquadrate. Venter initially flattened, later domed. Dorsum more or less flat throughout. Early whorls with strong, narrow, closely spaced, well elevated ribbing. Ribs straight or slightly flexed and prorsiradiate, thickening across the venter, frequently bifurcating, sometimes with incipient trituberculation. Ribs gradually thicken and become slightly more separated on the body chamber. Suture with narrow stemmed, undercut, very deeply bifid saddles and regularly trifid lobes; first lateral lobe very deep.

Dimensions:	Maximum diameter (D)	Whorl height (WH)*	Whorl thickness (WT)*	Umbilicus (U)*
F1266 QM	105mm	40%	39%	40%
F10477 GSQ	300mm	37%	35%	42%
F1264 QM	288mm	36%	36%	41%
F1598 QM	166mm	40%	42%	42%

* Dimensions expressed as % of total diameter

Remarks: Tropaeum undatum Whitehouse (1926, p. 215), as now interpreted, embraces medium sized to quite large forms with a subquadrate whorl section, loose crioceratid coiling and essentially unmodified ornament on the body chamber. Tropaeum rarum Whitehouse (1926, p. 216, pl. 36, figs 1a-b) is united with T. undatum together with a specimen from "Roma" referred to T. arcticum (Stolley) by Whitehouse (1926, p. 215).

Tropaeum arcticum occurs in the Aptian of Spitsbergen. The writer has not seen Stolley's original illustration, but according to Casey (1960, p.41), the type is "a small crushed phragmocone lacking the inner whorls". Frebold (1930, pl. 16, figs 1-2) illustrated large fragments from Spitsbergen as *T. arcticum*, and Frebold and Stoll (1937) subsequently referred to that species a small fragment figured from Spitsbergen by Sokolov & Bodylevsky (1931, pl. 12, fig. 3) as *Crioceras* cf. *gracile*. As *Tropaeum arcticum* is known only from fragments it is inadvisable to refer the better understood Queensland form to the Spitsbergen species.

Tropaeum australe (Moore), interpreted from the neotype (F1388 GSQ) from the "Walsh River" (Blackdown Formation) designated by Whitehouse (1926, p.214) is similar in whorl section and ribbing, but is more tightly coiled.

Whitehouse (1926, p.215) thought that the specimen (F1366 QM) from "Roma" (Doncaster Member), referred by him to *Tropaeum arcticum* (Stolley), was closely related to the holotype (F1390 QM) of *Australiceras transiente* Whitehouse (1926, p. 212, pl. 34, figs 3a-b) from "Walsh River" (Blackdown Formation). However, a critical comparison of the two specimens revealed no close relationship. The writer has placed the latter in synonymy with *Australiceras jacki* (Etheridge Jnr).

A form from the *Tropaeum australe* zone of Arctic Canada (Jeletzky, 1968) identified by Jeletzky (1964, p. 68, pl. 20, fig. 2) as

T. undatum Whitehouse is closely comparable and may be conspecific.

Casey (1960, p.41) remarked upon the similarity of ribbing of the nucleus of Tropaeum subarcticum Casey (1960, pl. 8, figs 3a-c) to that of the specimen (F1366 QM) referred to T. arcticum (Stolley) by Whitehouse (1926, p. 215). However, other specimens of T. subarcticum figured by Casey (1960, pl. 10, fig. 1, text fig. 12) show more resemblance to T. australe (Moore). Tropaeum subarcticum occurs in the upper Aptian nutfieldensis Zone of England.

Well preserved specimens of Tropaeum mozambiquense (Krenkel), described from Mozambique by da Silva (1962, p. 21, pl. 9 figs 1-2; pl. 10, fig. 1; pl. 11, fig. 1; pl. 12, fig. 1; pl. 13, fig. 1; pl. 14, fig. 1) and compared with T. rarum Whitehouse, are possibly closer to T. australe (Moore) than T. undatum Whitehouse.

Occurrence:

Doncaster Member: "Roma" (Whitehouse, 1926); "Pickanjinnie"; GAB2123; SB123?

Blackdown Formation: "Walsh River" (Whitehouse, 1926).

Age: Late Aptian

Tropaeum leptum (Etheridge Jnr), 1909

Pl.23, fig.2; pl.24, fig.4; text fig.9B

Synonymy:

1909 Crioceras? leptus Etheridge Jnr, p. 143, pl. 30, figs 1-3;pl.34,fig.2?

1926 Tropaeum leptum (Etheridge Jnr); Whitehouse, p. 215.

1961 "Tropaeum" leptum (Etheridge Jnr); Woods, p. 6.

Types: Holotype: F1381 GSQ Locality: "Lind River", Blackdown Formation, upper Aptian.

Material: One large partly crushed individual.

Specific diagnosis: Large *Tropaeum* with crioceratid coiling; later whorls almost in contact; whorl section elevated; flanks convergent ventrally; venter narrowly rounded; early whorls with strong, narrow, closely spaced, blunt non-tuberculate ribs; ribs on body chamber essentially similar, but thicker and with slightly wider spacing.

Description: Large; coiling crioceratid; nucleus not present; later whorls almost in contact. Whorl section elevated; flanks convergent ventrally. Venter narrowly rounded. Dorsum almost flat. Early whorls with strong, narrow, closely spaced, blunt, non-tuberculate ribs. Ribs straight or slightly flexed on flanks, commonly bifurcating, thickened across the venter. Ribs gradually thicken and become slightly more separated on the body chamber. Strong growth lines parallel ribs on body chamber. Suture with narrow stemmed, undercut, very deeply bifid saddles and regularly trifid lobes; first lateral lobe very deep. Last septum developed at a whorl height of approximately 140mm. Body chamber occupying half of final whorl.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1381 GSQ	215mm	40%	30%	38%
CPC 9819	450mm	39%	-	45%

Remarks: The large individual identified as *Tropaeum leptum* is somewhat crushed but clearly has an elevated whorl section comparable with that exhibited by the holotype (F1381 GSQ) described by Etheridge Jnr (1909, p. 143, pl. 30, figs 1-3) from the "Lind River" (Blackdown Formation). The present specimen, which was found in basal sediments of the Doncaster Member north of Mitchell (GAB2063) is much larger and more complete than the holotype.

Tropaeum leptum (Etheridge Jnr) has coiling and ribbing approaching that of *T. australe* (Moore) as interpreted by Whitehouse (1926, p. 214) but the former is distinguished by its more elevated whorl section.

Comparable overseas species include *Tropaeum caseyi* Collignon (1962, p. 18, pl. 222, fig. 965) from the late Aptian Zone of *Epicheloniceras tschernyschewi* of Madagascar, and a form from the *Tropaeum australe* Zone of Arctic Canada illustrated by Jeletzky (1964, p. 68, pl. 20, figs 1A-B; p. 72, pl. 22, figs 2A-C, 3A-C) as *Tropaeum* n.sp. aff. *T. arcticum* (Stolley).

Occurrence:

Doncaster Member: GAB2163

Blackdown Formation: "Lind River" (Etheridge Jnr, 1909); W10

(Woods, 1961).

Age: Late Aptian

Tropaeum imperator Howchin & Whitehouse, 1928

Pl.29, fig.1; pl.30, fig.2

Synonymy:

? 1886 Crioceras australe ? (Moore); Ratte, p. 133, pl. 2.

1928 Tropaeum imperator Howchin & Whitehouse, p. 487, figs 144-145.

1960 Tropaeum imperator Howchin & Whitehouse, Casey, p. 41.

1966 Tropaeum imperator Howchin & Whitehouse, Ludbrook, p. 189.

Type: Holotype; P13821 South Australian Museum collection.

Locality: "Flanks of Stuart's Range, 48 miles S.W. of Oodnadatta," (numbered Giddinna 5/609/6 by Ludbrook, 1966), Maree Formation Aptian.

Material: One specimen comprising most of the ultimate whorl.

Specific diagnosis: Enormous Tropaeum with loose crioceratid coils; whorl section subquadrate; early whorls with strong, closely spaced, non-tuberculate ribs; ribs gradually strengthen and become more widely spaced on penultimate whorl; ornament on ultimate whorl with abrupt change to heavy, distant, faintly tuberculate ribs.

Description: Initial whorls not present in this material. Whorl section subquadrate; flanks gently convex, convergent ventrally. Venter broadly rounded. Dorsum gently convex. Ribs on smaller end thick, well elevated, bluntly rounded, straight, about 20mm apart on flanks. Ornament changes abruptly to heavy, distantly spaced ribs about 10 septa before the last septum. Ribs on body chamber about 70mm apart on flanks and faintly trituberculate. Last septum at whorl height and thickness of approximately 150mm. Fine details of suture not preserved in this material except for first lateral lobe of last septum which is narrow stemmed, undercut and very deeply bifid.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
CPC 9820	630mm	21%	21%	52%
(larger end	-	180mm	180mm	
(smaller end	-	100mm	100mm	

Remarks: Although the early whorls are missing the present specimen is confidently referred to Tropaeum imperator Howchin & Whitehouse (1928, p. 487, figs 144-145) as the preserved portion shows the abrupt change on the ultimate whorl from close, comparatively light ribbing to heavy, distant costation. The holotype (P13821 South Australian Museum) is a somewhat larger individual (diameter 770mm). Tropaeum imperator is the largest known species of the genus.

The type species of Tropaeum, T. bowerbanki J. de C. Sowerby redescribed by Casey (1960, p. 25, pl. 4, figs 1-3; pl. 5, figs 1-2; pl. 6, fig. 1; text figs 7, 11a-b) from the Lower Greensand of England appears to be closely related to T. imperator. Tropaeum bowerbanki is widely distributed across N.W. Europe from England to the Urals and characterizes the topmost beds of the lower Aptian (Zone of Tropaeum bowerbanki) (Casey, 1960, p.29).

Crioceras deeckei described from Patagonia by Favre (1908, p.636, pl.36, fig.4; pl.37, fig.1; text fig.7) and Piatnizky (1938, p.81, pl.9, fig. 39) may also be compared with Tropaeum imperator. Favre and Piatnizky incorrectly assigned the Patagonian species a late Barremian age. Reference of Favre's species to the Aptian genus Tropaeum was suggested by Leanza (1963, p.221).

The relationship of Tropaeum imperator Howchin & Whitehouse and Australiceras lampros is discussed in the section of the latter species.

Occurrence:

Doncaster Member: GAB873

Maree Formation: Giddinna 5/609/6 (Ludbrook, 1966)

Age: Late Aptian.

Genus Australiceras Whitehouse, 1926

(= Columbiaticeras Royo y Gomez, 1945)

Type species (by original designation): Crioceras jacki Etheridge Jnr, Aptian, Eastern Australia.

Generic characters: Coiling typically crioceratid, ancyloceratid in early species. Similar to Tropaeum in mid-life, but initial whorls and sometimes the body chamber develop the trituberculate costae of Ancyloceras.

Range: Aptian.

Remarks: Spath (1931, p.656) advocated the abandonment of Australiceras Whitehouse (1926, p.208) in favour of Tropaeum Sowerby. However, Casey (1960, p. 44) retained the two as distinct genera, and maintained that this course clarified the evolutionary sequence within the Ancycloceratidae. Casey's view is adopted here.

Australiceras differs from Tropaeum primarily in its development of a tri tuberculate nucleus. Australian species of Australiceras tend to have a suture with broader stemmed saddles than those of species referred to Tropaeum. The degree of consistency of this feature in overseas species needs evaluation. Forms morphologically intermediate between the two genera (e.g. Australiceras lampros) are known, and the genera are clearly closely related.

Whitehouse (1926, p. 209) thought that species of Australiceras with crioceratid coiling occurred in the lower Aptian, while those with ancyloceratid coiling, which he tentatively included in the genus, were confined to the upper Aptian. Casey (1960, p. 19, text. fig. 5) (1961a, p.45) reviewed the stratigraphical and faunal associations of Australiceras and demonstrated that Whitehouse's sequence is, in reality, reversed. European species with ancyloceratid coiling are associated with early Aptian hoplitoids and occur stratigraphically below the crioceratid species. Crioceratid species in the Caucasus, India, California, and Columbia are associated with hoplitoids of late Aptian age. Collignon (1962) has since described an association of late Aptian hoplitoids and crioceratid species of Australiceras from Madagascar. Thus it seems probable that the Australian crioceratid species, which occur in a fauna lacking hoplitoids, are also late Aptian forms. No species of Australiceras with ancyloceratid coiling are known from Australia.

According to Casey (1960) (1961a) Australiceras is found only in Aptian strata. As noted in the section on overseas correlations, Australiceras asiaticum Matsumoto (1947) from the Neocomian of Japan is not congeneric with Australiceras. The genus is very widely distributed (text fig.3) and occurs in England, France, Northern Germany, Caucasus, southern Urals, India, Columbia and California (Casey, 1961a), Madagascar (Collignon, 1962) Zululand (Haughton, 1936) as well as Australia. In addition, the Patagonian species Crioceras sarasini (Favre, 1908) may belong to Australiceras.

Australiceras jacki (Etheridge Jnr), 1880

Pl.28, figs 3-4; pl.31, fig.1; pl.32, figs 1-2

Synonymy:

1880b Crioceras jackii Etheridge Jnr, p. 305, pl.17, figs 55-58.

1892 Crioceras australe (Moore); Etheridge Jnr, p. 499 (pars.), pl. 30, fig.7; pl.32, figs 1-5 only.

1909 Crioceras jackii Etheridge Jnr, p. 145 (pars.) pl. 32, fig. 1; pl. 33, fig. 1; pl. 35, fig. 1; pl. 37, fig. 1; pl. 38, fig. 3 only.

1926 Australiceras jacki (Etheridge Jnr); Whitehouse, p. 209, pl. 34, fig. 2,

1926 Australiceras aff. irregulare (Tenison Woods); Whitehouse, p. 210.

1926 Australiceras robustum Whitehouse, p. 211.

1926 Australiceras transiente Whitehouse, p. 212, pl, 34, figs 3a-b.

1961 Australiceras jacki (Etheridge Jnr); Woods, p. 3,

1966 Australiceras sp. nov. aff A. jacki (Etheridge Jnr);
Skwarko, p. 123, pl. 14, fig. 13.

Types: Crioceras jackii Etheridge Jnr. Lectotype: (now selected) F1385 GSQ (specimen figured by Etheridge Jnr, 1880, pl. 17, figs. 55, 56, 57).

Paralectotype: (now selected) F1386 GSQ (specimen figured by Etheridge Jnr 1880, pl. 17, fig. 58). Locality: Both from "Tate River", Blackdown Formation, upper Aptian.

Australiceras robustum Whitehouse Holotype: AM collection (fide Whitehouse 1926, p. 211). Locality: "Sources of Barcoo, Ward & Nive Rivers, South Central Queensland", probably from Doncaster Member, upper Aptian.

Australiceras transiente Whitehouse Holotype: F1390 QM. Locality: "Walsh River", Blackdown Formation, upper Aptian.

Material: One large reasonably complete individual, 4 smaller less complete individuals and several large portions of body chambers.

Specific diagnosis: Crioceratid coiled Australiceras, initial whorls slightly separated; later whorls in contact; early whorls with narrow, well elevated, blunt, closely spaced ribs; on later whorls ribs thicken and gradually become weakly elevated and widely spaced on body chamber; early whorls with prominent, trituberculate ribs separated by 1 or more non-tuberculate ribs; ribs of body chamber non-tuberculate.

Description: Medium to quite large sized (largest complete specimen in present collections 280mm diameter, but larger specimens represented by fragmentary body chambers). Coiling crioceratid, initial whorls slightly separated; later whorls contact. Whorl section varies with growth; initial whorls subcircular in cross section; later whorls subrectangular in section; body chamber with trapezoidal whorl section with flanks convergent ventrally. Venter initially rounded, later flat, finally broadly arched. Dorsum almost flat throughout. Body chamber forms at least one complete volution. Early whorls with narrow, well elevated blunt, closely spaced ribs, straight or slightly flexed, thickened across the venter, occasionally bifurcating. Ribs on later whorls thicken and gradually become broad,weakly elevated, and widely spaced on the body chamber. Well preserved specimens with fine growth lines paralleling ribs. Ribs on flanks of initial whorl tend to develop 2 rows of lateral tubercles. Tri tuberculate ribs on flanks of 2nd and 3rd whorls separated by 1 or more non-tuberculate ribs. Tubercles variable in size and prominence. Later whorls without tubercles. Suture line complex, with broad stemmed, deeply bifid saddles and deep, regularly trifid lobes.

Dimensions:	Maximum diameter	Diameter measurements taken	Whorl height	Whorl thickness	Umbilicus
Lectotype	(D)	(D')	(WH)	(WT)	(U)
F1385 GSQ	80mm	-	41%	41%	35%
F1390 QM	-	88	45%	41%	36%
CPC 9816	280	-	34%	32%	36%

Remarks: Heteromorph ammonites display considerable individual variation in whorl section, ribbing and tuberculation, so adequate provision should be made for wide intra-specific variation within heteromorph species. Earlier workers made insufficient allowance for such variation and the present interpretation of *Australiceras jacki* (Etheridge Jnr) is thus broader than that adopted by Whitehouse (1926, p. 209). *Australiceras jacki*, as now interpreted, is a fairly large species characterized by more or less tight crioceratid coiling, a moderately to very prominently trituberculate nucleus, and a gradual transition from ornament of early whorls to that of the ultimate non-tuberculate body chamber. Noticeable, but apparently random, variation occurs in the point of cessation of tuberculation and in the size of tubercles. *Australiceras robustum* Whitehouse (1926) and *A. transiente* Whitehouse (1926) are regarded as intra-specific variants.

Australiceras jacki (Etheridge Jnr) may be compared with several species from other continents. They include *Australiceras argus*

Anderson (1938, p.211, pl.70, figs 1-2) from California, _A. rabenjanaharyi_ Collignon (1962, p.26, pl.226, fig. 969; pl.227, fig. 969) from Madagascar and a form from Kachh, India, described by Spath (1931, p.657, pl.124, figs 4, 9-12) as _Tropaeum_ sp. ind. aff. _T. australis_ (Moore). The Californian, Madagascan and Indian occurrences are all associated with hoplitoids of late Aptian age. Thus a late Aptian age may be inferred for the Australian occurrences.

Australiceras bolivari (Royo y Gomez, 1945, p.470, pl.75, fig.2) from Columbia, is also closely related to _A. jacki_ but has much smaller tubercles. Royo y Gomez erected a new genus _Columbiaticeras_ for the Columbian species, to which he assigned a Barremian age. Casey (1961a, p.45) subsequently demonstrated the late Aptian age of this species.

Australiceras irregulare (Tenison Woods, 1883b) is probably the most closely allied Australian species. _A. jacki_ may be distinguished from this form by its more tightly coiled nucleus, and its broader, less elevated ribbing on the body chamber.

Occurrence:

Doncaster Member: "Sources of the Barcoo, Ward and Nive Rivers" (Etheridge Jnr, 1909) ; "Hughenden" (Whitehouse, 1926); GAB1036; GAB2142.

Blackdown Formation: "Tate River" (Etheridge Jnr, 1880); "Walsh River" (Etheridge Jnr, 1892) and several localities reported by Woods (1961).

Maryborough Formation: "Woody Island, Harvey Bay" (Whitehouse, 1926).

Mullaman Beds : TT17 (Skwarko, 1966).

Age: Late Aptian.

Australiceras irregulare (Tenison Woods), 1883

Pl.25, figs 1-2; text fig.9A,C

Synonymy:

1883b Crioceras irregulare Tenison Woods, p.151, pl.8, fig.2.

1892 Crioceras irregulare Tenison Woods; Etheridge Jnr, p.501, pl.33, fig.1; pl.42, fig.16.

1909 Crioceras jackii Etheridge Jnr, p.145 (pars.), pl.36, fig.1; pl.37, fig.2.

1926 Australiceras irregulare (Tenison Woods); Whitehouse p.210, pl.37, figs 1a-b.

1926 Australiceras gracile (Sinzow); Whitehouse, p.211, pl.34, fig.4.

1961 Australiceras irregulare (Tenison Woods); Woods, p.3, 6.

1964 Australiceras cf. A. irregulare (Tenison Woods); Day, p.18, table 3.

Type: Holotype: Mining Museum collection (fide Whitehouse, 1926, p.210).

Locality: "Palmer River", Blackdown Formation, upper Aptian.

Material: Two well preserved specimens and several fragments.

Specific diagnosis: Crioceratid coiled Australiceras; initial whorls loosely coiled and widely separated; later whorls in close promimity; initial 3 whorls with irregularly tri-tuberculate, closely spaced ribs; ribs of body chamber essentially similar, but thicker, slightly more widely spaced and non-tuberculate.

Description: Medium sized. Coiling crioceratid; initial whorls loosely coiled and widely separated; later whorls in close proximity. Whorl section initially subcircular; later whorls trapezoidal with flanks flattened and convergent ventrally. Venter gently convex throughout. Dorsum initially slightly convex, later flat. Initial whorls ornamented with narrow, well elevated, blunt, closely spaced ribs, straight or slightly flexed, occasionally bifurcating. Ribs continuous but sometimes reduced in height across venter and dorsum. Ribs gradually strengthen and become more widely separated on body chamber. Flank ribs of initial 3 whorls irregularly tri-tuberculate. Later whorls without tubercles. Tubercles variable in size and prominence, weak to very strong. Sutures well separated, complex, with comparatively broad stemmed, deeply bifid saddles and regularly trifid lobes; first lateral saddle very deep.

Dimensions:	Maximum diameter (D)	Diameter measurements taken (D')	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
F35624 UQ	(165 mm	-	36%	39%	41%
	(	105 mm	34%	39%	46%
	(	68 mm	32%	35%	50%
CPC 9259	-	75 mm	30%	30%	50%

Remarks: Australiceras irregulare (Tenison Woods, 1883b) is closely related to A. jacki (Etheridge Jnr, 1892), but the former differs in its loosely coiled nucleus, slightly more depressed whorl section and its ornament on the body chamber, which except for a lack of tubercles, is essentially the same as that of early whorls. A. irregulare displays the same variation in strength of tuberculation and in the point of its cessation as A. jacki.

Australiceras lampros (Etheridge Jnr, 1909) has initial coiling like that of A. irregulare (Tenison Woods), but attains a much larger size, and its ultimate whorls bear heavy, distant, trituberculate ribs.

The Madagascan species Australiceras hirtzi Collignon (1962, p.19, pl. 223, fig. 966; pl. 224, fig. 967; pl. 225, fig. 968) is perhaps allied to A. irregulare, although it is much larger and has stronger tuberculation continued to a later stage than the Queensland form. A. hirtzi is associated with hoplitoids of late Aptian age (Acanthohoplites bigoureti Zone).

Apparently several comparable species also occur in the Aptian of the Caucasus. Unfortunately, I have seen few illustrations of these forms. Whitehouse (1926, p.211) thought a specimen now referred to Australiceras irregulare was identical with a Russian one figured by Sinzow as "Crioceras gracile". Sinzow evidently illustrated a variety of forms under this name (Whitehouse,1926, p. 211; Casey, 1960, p.43; Collignon, 1963, p.20). Casey (1960, p. 43) noted that Sinzow's nominate species, originally proposed in

1872 as "*Ancyloceras gracile*" was pre-occupied. He renamed the species *Tropaeum rossicum*. I have not seen the forms illustrated by Sinzow, but it seems inadvisable to identify the Queensland species with that of Sinzow.

Australiceras ramososeptatum (Anthula) as figured from the Caucasus by Drushchitz and Kudryavtzeva (1960, pl. 39, fig.1) (referred to *Ammonitoceras* by these authors) is quite similar. According to Casey (1961a, p.45) Anthula assigned this species an early Aptian age, but Drushchitz and Kudryavtzeva (p. 294) give its age as late Aptian.

Occurrence:

Doncaster Member: "Victoria Downs, Warrego" (Whitehouse, 1926); RD90; GAB1137.

Blackdown Formation: "Palmer River" (Tenison Woods, 1883); "Walsh River" (Whitehouse, 1926).

Age: Late Aptian.

Australiceras cf. *lampros* (Etheridge Jnr), 1909

Pl.30, fig.1

Synonymy:

cf. 1909 *Crioceras lampros* Etheridge Jnr, p. 157, pl. 48, figs 1-2.

cf. 1926 *Australiceras lampros* (Etheridge Jnr); Whitehouse, p. 212, pl. 35, figs 1a-b.

cf. 1926 *Tropaeum lampros* (Etheridge Jnr); Whitehouse, pl. 35, figs 1a-b (plate explanation)

cf. 1928 *Australiceras lampros* (Etheridge Jnr); Howchin & Whitehouse, p. 490.

cf. 1960 Tropaeum lampros (Etheridge Jnr); Casey, p.29.

Type: Holotype: GSQ collection. Locality: "Walsh River", Blackdown Formation, upper Aptian.

Material: Three large septate fragments.

Specific diagnosis: Crioceratid coiled Australiceras of enormous size; initial whorls loosely coiled, bearing closely spaced, narrow, irregularly tri tuberculate ribs; ribs of intermediate whorls non-tuberculate; ribs of final whorls thick, markedly trituberculate and widely separated.

Description: Initial coil not present in this material. Whorl section sub-trapezoidal; flanks convex. Venter domed. Dorsum flat. Septate fragments with thick, well elevated, strongly tri tuberculate ribs, about 40mm apart on smaller specimens and about 50mm apart on largest specimen. Septa closely crowded. Suture with somewhat narrow stemmed, deeply bifid saddles and regularly bifid lobes; first lateral saddle very deep.

Dimensions:

		Whorl height (WH)	Whorl thickness (WT)
CPC9817	(larger end)	160mm	160mm
	(smaller end)	130mm	130mm
CPC9818	(larger end)	115mm	115mm
	(smaller end)	105mm	105mm

Remarks: Three specimens now compared with Australiceras lampros have stronger tubercles than the type of this species described by

Etheridge Jnr (1909, p. 157, pl. 48, figs 1-2) from the "Walsh River" (Blackdown Formation). The last septum of the holotype occurs at a whorl height and thickness of approximately 120mm. The largest specimen in the present collection (CPC9817) represents an even larger form, as it is still septate at a whorl height and thickness of 160mm. A specimen of *Australiceras lampros* from "Glendower Station, Flinders River" (Doncaster Member), described by Whitehouse (1926, p. 212, pl. 35, figs 1a-b) as *Australiceras lampros* in the text and *Tropaeum lampros* in the plate explanation, is smaller than the holotype and has even less prominent tubercles. As noted by Whitehouse (1928, p. 213) and Howchin and Whitehouse (1928, p. 290) the initial whorls of the holotype have been rediscovered. These resemble those of *A. irregulare*.

Australiceras lampros (Etheridge Jnr) is the largest known species of *Australiceras* and appears to be closely related to the largest known species of *Tropaeum*, *T. imperator* Howchin and Whitehouse (1928) from South Australia. Whitehouse (1926, p.212, pl. 35, figs 1a-b) was undecided as to the generic allocation of a specimen from "Glendower Station, Flinders River". Subsequently, Howchin and Whitehouse (1928, p. 491) concluded that this specimen was morphologically intermediate between *Tropaeum* and *Australiceras*. Casey (1961, p.29) evidently interpreted *Australiceras lampros* from Whitehouse's specimen housed in the British Museum (Natural History), and referred Etheridge Jnr's species to *Tropaeum*. As the holotype is distinctly trituberculate the species is now included in Australiceras.

Crioceras sarasini described by Favre (1908, p. 638, pl. 36, figs 1-3; pl. 37, fig. 2) from the Lake Charabuco district of Patagonia, closely approaches Australiceras lampros in size, coiling, rib development, and the later whorls are strongly trituberculate. Favre (1908) incorrectly assigned his species a late Neocomian age.

Occurrence:

Doncaster Member: "Glendower Station, Flinders River" (Whitehouse, 1926); GAB871 (cf.); GAB883 (cf.).

Blackdown Formation: "Walsh River" (Etheridge Jnr, 1909).

Age: Late Aptian.

Indeterminate species of Australiceras

Specifically indeterminate specimens of Australiceras occur in the Doncaster Member at RD90; RD122; GAB1134; GAB1136; GAB2098 and GAB2167.

Genus Lithancylus Casey, 1960

Details of the genus Lithancylus are given in Day (1967c) (appendix C).

Lithancylus australis Day, 1967

This form was fully discussed by Day (1967c) (appendix C).

Subfamily Helicancylinae Hyatt, 1894

Remarks: Casey (1961a, p.76) resurrected Hyatt's nominate family Helicancylidae as a subfamily of Ancyloceratidae thereby accommodating diminutive heteromorphs with simplified ornament on the terminal book. He included the Aptian genera Helicancylus Gabb, Toxoceratoides Spath, and Tonohamites Spath. The Barremian genera

Acrioceras Hyatt, Lytocrioceras Spath and Leptoceras Uhlig were also tentatively referred to the subfamily.

Genus Toxoceratoides Spath, 1924

Type species (by original designation):
Toxoceras royerianum d'Orbigny, 1842, lower Aptian (deshayesi Zone), France.

Generic diagnosis: Small; coiling ancyloceratid, sometimes initially helicoid; ornament except that of final hook as in Ancyloceras, with periodic trituberculate ribs; final hook with closely spaced, narrow, sharp ribs, bifurcating or trifurcating irregularly from umbibical tubercles; suture line as in Ancyloceras.

Remarks: Wright (1957a, p.L212) regarded Toxoceratoides as a nomen dubium and a possible synonym of Hamiticeras Anderson (1938). Casey (1961a, p.77), after reinterpretation of the type species of Toxoceratoides, concluded that the taxon was recognisable. According to Casey, Toxoceratoides ranges from the top of the Barremian to the deshayesi Zone of the lower Aptian, and is found in Europe and East Africa. The species described below as "Toxoceratoides" sp. is only provisionally included in the genus.

"Toxoceratoides" sp.

Pl.26, fig.4; pl.27, fig.1; pl.28,
figs 1-2; text fig.9D

Synonymy:

1927 Toxoceratoides ? sp. Whitehouse, p. 146.

1961 Toxoceratoides (?) sp. nov. Woods, p. 3, 6.

1964 Toxoceratoides ? sp. Day, p.18, table 3.

Material: One reasonably complete individual and three lacking the initial coil.

Specific diagnosis: Medium sized, nucleus with helicoid coiling; ribbing like that of *Toxoceratoides* but possessing only ventro-lateral tubercles.

Description: Medium sized. Nucleus with helicoid coiling; shaft gently curved, septate; final hook with wide radius. Whorl section initially subcircular, becoming subquadrate on body chamber. Ribs strong, narrow, sharp, closely spaced, strongly prorsiradiate, sometimes rursiradiate; occasionally bifurcating on the flanks. Ribbing interrupted across the venter, continuous across the dorsum. Early ribs apparently non-tuberculate; each rib on body chamber with a pair of small ventro-lateral tubercles. Suture with broad stemmed bifid saddles and a deep, trifid first lateral lobe. Body chamber occupying final hook.

Dimensions:	Whorl height (WH)	Whorl thickness (WT)
F16762 CPC (larger end)	31mm	29mm
(smaller end)	18mm	16mm
F2984 GSQ (larger end)	27mm	25mm
(smaller end)	15mm	15mm

Remarks: The ribbing of "*Toxoceratoides*" sp. is sharp and close like that of *Toxoceratoides* Spath as interpreted by Casey (1960, p.77), but lacks lateral tubercles. *Tonohamites* Spath as interpreted by Casey (1960, p.54), lacks lateral tubercles but has coarse blunt ribs. The species is perhaps closer to Toxoceratoides and is provisionally referred to that genus.

Ancyloceras taylori Etheridge Jnr (1892, p.498, pl.42, fig. 13) from the "Walsh River" (Blackdown Formation) is similar but has a planispiral initial coil. Whitehouse (1926, p.216) included Etheridge Jnr's species in Toxoceratoides, but reference to Tonohamites is probably more appropriate.

Occurrence:

Doncaster Member: "portion 454, parish of Hodgson" (Whitehouse, 1927); Bungeworgorai Ck. below Mt. Abundance homestead; S. bank of Maranoa R. 1½ miles W. of Mitchell; RD92; L106 GSQ; GAB1115.

Blackdown Formation: W29 (Woods, 1961).

Age: Late Aptian

Family Labeceratidae Spath, 1925

(= Aleteceratidae Whitehouse, 1926; Myloceratidae Spath, 1939)

Remarks: Representatives of the family may have regular crioceratid coiling throughout life, but are typically coiled in an open spiral at first, with later whorls sometimes in contact and the shell ending in a hook. The whorl section ranges from depressed elliptical to very compressed rectangular. The aperture may have well developed, rounded lateral lappets. All genera have fine branching ribs that pass over the venter, usually with ventro-lateral or umbilical tubercles. The suture has broad, bifid saddles and generally narrow trifid lobes.

Spath (1925, p.191) erected the family Labeceratidae for Labeceras Spath (1925) and the European genus Hamitoides Spath (1925). Whitehouse (1926) referred Labeceras together with Appurdiceras Whitehouse (1925) to the family Hamitidae and erected a new family Aleteceratidae for Algerites Pervinquiere, Myloceras Spath, Aleteceras Whitehouse (1926) and Flindersites Whitehouse (1926). Spath (1939, p.601) subsequently queried the inclusion of Hamitoides in the Labeceratidae and thought the family was related to the Scaphitidae. He regarded Whitehouse's genera, Flindersites and Aleteceras as synonyms of Myloceras, and renamed as Myloceratidae, Whitehouse's family Aleteceratidae. Spath (1939, p.578) also excluded Algerites from that family.

Wright (1957a, p.L231) placed the Myloceratidae in synonymy with the Labeceratidae which was referred to the Scaphitacea. He included in the family the genera Labeceras Spath with Appurdiceras Whitehouse as its subgenus, Myloceras Spath with Aleteceras Whitehouse and Flindersites Whitehouse as synonyms, Ellipsoceras Collignon (1950) with Abadieceras Collignon (1950) as its synonym, and Hamitoides Spath doubtfully. Luppov & Drushchitz (1958, p. 125) also placed the Labeceratidae in the Scaphitacea but included only the genera Labeceras and Myloceras.

Wiedmann (1962, pp.98-99) thought the resemblance of Labeceras to Scaphites was homeomorphic. He considered the Labeceratidae to be closely related to the Anisoceratidae, and treated the former group as a subfamily of the latter. The writer accepts Wiedmann's conclusions on the relationship between labeceratids and anisoceratids, but prefers family rank for the Labeceratidae as the group is very distinct both geographically and chronologically.

Labeceratids are known only from Australia, New Guinea, Madagascar, Mozambique and Zululand. The genera *Labeceras* and *Myloceras* occur in all these areas; *Appurdiceras* is confined to Madagascar; *Ellipsoceras* is found only in Madagascar. In Madagascar, where faunas may be correlated directly with those of Europe, *Labeceras* and *Myloceras* range from the *cristatum* Subzone (uppermost middle Albian) to the *inflatum* Zone (lower upper Albian) (Collignon, 1963). However, in Australia, where maximum development of the family occurs, faunas with *Labeceras* and *Myloceras* cannot be dated so precisely. Possibly, these genera range higher in the upper Albian and/or lower in the middle Albian in Australia.

The stratigraphically oldest labeceratid in Australia is the large crioceratid coiled species *Myloceras* cf. *axonoides* (Etheridge Jnr) found in the Coreena Member. *Labeceras* and *Appurdiceras* first appear in the Toolebuc Limestone. These genera, together with *Myloceras* are common in that unit and in the overlying Allaru Mudstone. All three genera have a sparse representation in the Mackunda Formation. There is no stratigraphic evidence to support the development of labeceratids presumed by Wiedmann (1965, p. 443, text fig. 12).

Genus Labeceras Spath, 1925

Type species (by subsequent designation, I.C.Z.N. opinion 556, 1958): *Labeceras bryani* Whitehouse, 1926, lower upper Albian, Queensland.

Generic diagnosis: Small, with initial crioceratid coil of 2 whorls. Shaft curved and septate up to commencement of final hook. Aperture obliquely facing shaft. Lappets well developed. Whorl section subcircular to laterally compressed and subrectangular. Ribs fine or coarse, close or relatively distant; slightly flexed and sometimes bifurcating. Umbilical tubercles may occur on shaft and hook and bundle ribs into groups of 2, 3 or 4. Ventro-lateral tubercles virtually absent. Suture with broad, shallowly bifid saddles and narrow trifid lobes.

Range: Upper middle-lower upper Albian.

Remarks: Whitehouse's manuscript name *Labeceras* was fi.st published by Spath (1925), who referred to the genus two Australian species "*Labeceras taylori* (Etheridge)" and "*L. laqueus* (Etheridge)", and a new species and variety *L. plasticum* and *L. plasticum* var *crassum* from Portuguese East Africa. However, his designation (Spath, 1925, p.191) of a specimen (C 25355) in the British Museum, the suture line of which was figured as *Labeceras* sp. nov., as type species is invalid since no nominal species was cited.

Whitehouse (1926) in his description of *Labeceras*, named the specimen C25355 *Labeceras papulatum* and selected that species as type. This designation is similarly invalid for *Labeceras papulatum*

Whitehouse (1926) was not a species originally included in Labeceras by Spath.

Roman (1938) selected "Labeceras taylori Etheridge 1909" as type species. Wright (1957b) noted that this selection, although valid, was contrary to the accepted usuage of Labeceras. The original specimen described as "Ancyloceras taylori" by Etheridge Jnr (1892, pl.42, fig. 13) is an Aptian ancyloceratid, possibly referrable to Tonohamites Spath. Specimens later referred to this species by Etheridge Jnr (1909, pl.49, figs 3, 5, 6) are not congeneric, and were named Labeceras bryani by Whitehouse (1926, p.227).

Wright (1957b) proposed use of the plenary powers to designate Labeceras bryani,Whitehouse the type species of Labeceras Spath. Wright's proposal was accepted by the International Commission on Zoological Nomenclature in 1958 (opinion 556). In that opinion the generic name Labeceras and the specific name bryani were added to the respective lists of accepted generic, and accepted specific, names in zoology.

Labeceras Spath (1925) is closely related to Appurdiceras Whitehouse (1926). The latter was treated as a subgenus of the former by Wright (1957a), but the writer prefers a generic separation. Appurdiceras differs from Labeceras principally in tuberculation. In Appurdiceras ventro-lateral tubercles are well developed and umbilical tubercles are lacking; in Labeceras the tuberculation pattern is reversed, or tubercles are altogether absent.

Ancyloceratid coiled species of Myloceras Spath (1925) attain a larger size before uncoiling than those of Labeceras and all species of Myloceras develop ventro-lateral tubercles.

Labeceras is known only from Mozambique (Spath, 1925), Zululand (Besaire, 1930) (Venzo, 1936), Madagascar (Collignon, 1950, 1963), New Guinea (Glaessner, 1958) and Australia. In Mozambique, Zululand and Madagascar, Labeceras is a minor element in faunas that are very similar to those of Western Europe and include numerous European species. The presence of European species, particularly mortoniceratids, permits direct reference to the standard Albian sequence, the Gault of England. In Madagascar, Labeceras occurs in strata correlated with the cristatum Subzone (topmost middle Albian) and the inflatum Zone (lowest zone of the upper Albian) (Collignon, 1963). In Mozambique and Zululand, Labeceras is found in equivalents of the inflatum Zone (Spath, 1925) (Venzo, 1936). Four of the Australian species of Labeceras, which are closely related to those in Madagascar, Mozambique and Zululand, are associated at one horizon in the Tambo - Augathella area, with mortoniceratids that indicate a correlation with the lower subzones of the inflatum Zone. Thus evidence from overseas occurrences of Labeceras and local association with mortoniceratids suggest that the time range of the genus spans only the cristatum-inflatum interval. However, the total time range of Labeceras may exceed this, as Whitehouse (1928) reported the genus from horizons of late

late Albian age near Darwin.

Four species are identified in the present material. The oldest species occur in the Toolebuc Limestone but none has been specifically determined. Labeceras bryani Whitehouse occurs near the base and near the middle of the Allaru Mudstone. The remainder, L. compressum Whitehouse, L. papulatum Whitehouse and L. trifidum Whitehouse appear to be confined to the middle part of the Allaru Mudstone. Indeterminate species of Labeceras also occur in the Mackunda Formation.

Labeceras bryani Whitehouse, 1926

Pl.8, fig.1

Synonymy:

1909 Crioceras taylori Etheridge Jnr, pl. 49, figs 3, 5, 6 only.

1926 Labeceras bryani Whitehouse, p. 227, pl. 39, figs 4a-b.

Type: Holotype: AM collection (fide Whitehouse, 1926). Locality: "sources of the Barcoo, Ward and Nive Rivers, South Central Queensland, "probably from Allaru Mudstone, lower upper Albian.

Material: Two portions of shaft and hook.

Specific diagnosis: Labeceras with thick, sharp, widely spaced, non-tuberculate ribs; whorl section subcircular throughout.

Description: Medium sized. Only shaft and hook represented in this material. Whorl section not determinable. Ribs thick, sharp, non-tuberculate, widely spaced, about 2mm apart on mid-flank. Ribs on shaft strongly prorsiradiate. Ribs on hook rectiradiate. Aperture obliquely facing shaft. Lappets well developed. Shaft septate up to commencement of hook. Suture with broad stemmed, shallowly bifid saddles and narrow, trifid lobes.

Dimensions:

CPC9840	(whorl height of shaft	c.13mm
	(whorl height of hook	c.13mm

Remarks: Only one side of the present specimens is preserved, but the coarse, relatively distant ribs correspond to those highly characteristic of the holotype figured by Whitehouse (1926, pl. 39, fig. 4a) and specimens figured as Crioceras taylori by Etheridge Jnr (1909, pl. 49, figs 3, 5, 6). Following the submission by Wright (1957b) Labeceras bryani was designated type species of Labeceras and the name added to the official list of accepted specific names in zoology by Opinion 556 of the International Commission on Zoological Nomenclature.

Judging from the figures given by Collignon (1950, p. 79, pl. 13, figs 5-5a) Labeceras crassicostatum from early late Albian sediments of Madasgascar, appears to be allied to L. bryani. A critical comparison of actual specimens of the Australian and Madagascan forms might reveal very close relationships at the specific level. The exceptionally large species Labeceras gracile Collignon (1963, p.56, pl. 262, fig. 1140) from the Zone of Dipoloceras cristatum (topmost middle Albian) of Madagascar, is perhaps more distantly related.

Labeceras bryani occurs near the base and near the middle of the Allaru Mudstone in the Tambo-Augathella area.

Occurrence:

Allaru Mudstone: "sources of the Barcoo, Ward and Nive Rivers, south central Queensland" (Whitehouse, 1926); GAB1927; GAB2096.

Age: Early late Albian.

Labeceras compressum Whitehouse, 1926

Pl.3, fig.3; pl.4, figs 3-4

Synonymy:

1926 Labeceras compressum Whitehouse, p.228, pl. 36, fig. 5; pl.39, figs 5a-b.

1964a Labeceras (Labeceras) compressum Whitehouse; Reyment, p.24, pl.1, figs 3-4.

1966 Labeceras (Labeceras) compressum Whitehouse; Ludbrook, p.189.

Type: Holotype: F1600 QM. Locality: "Tower Hill, Muttaburra", Allaru Mudstone, lower upper Albian.

Material: Six portions of shaft and hook.

Specific diagnosis: Labeceras with fine, closely spaced, essentially non-tuberculate ribs; whorl section laterally compressed, subrectangular throughout.

Description: Medium sized. Only shaft and hook preserved in this material. Whorl section laterally compressed, subrectangular. Ribs thin, rather blunt, non-tuberculate or with rudimentary umbilical and ventro-lateral tubercles. Ribs closely spaced, about 4 per 5mm on mid flank, continuous across dorsum and venter. Ribs on hook and shaft strongly prorsiradiate dorsally, becoming rectiradiate ventrally. Aperture obliquely facing shaft. Lappets well developed. Shaft septate up to commencement of hook. Suture with broad stemmed, shallowly bifid saddles and narrow trifid lobes.

Dimensions:

		Whorl height (WH)	Whorl thickness (WT)
Holotype F1600 QM	(aperture	22mm	14mm+
	(shaft	17mm	11mm+
ANU 17903	(aperture	c.16mm	-
	(shaft	c.15mm	10mm

Remarks: The present specimens identified with *Labeceras compressum* closely resemble the holotype (F1600 QM), a shaft and hook figured by Whitehouse (1926, pl. 39, figs 5a-b), but the former have better preserved ornament. The combination of a laterally compressed, subrectangular whorl section and fine non-tuberculate ribbing makes *L. compressum* a distinctive species.

Labeceras compressum Whitehouse appears to be very closely related to *L. hourcqi* (Collignon 1950, p.78, pl.13, figs 4-4a; pl.14, figs 1-1a) (1963, p.50, pl.259, fig. 1128) from the Zone of "*Pervinquiera*" *inflata* (lower upper Albian) of Madagascar. The two may prove to be conspecific when a direct comparison of Australian and Madagascan specimens is made.

In Queensland, *Labeceras compressum* occurs stratigraphically near the middle of the Allaru Mudstone. In South Australia, the species is found in the Wooldridge Limestone Member (Reyment, 1964a), and in the upper part of the Maree Formation (Ludbrook, 1966).

Occurrence:

Allaru Mudstone: "Tower Hill, Muttaburra" (Whitehouse, 1926); Tributary of Brutus Creek about 1 mile S.E. of "Currane" (grid ref. 260083 Longreach); GAB1085; GAB1394.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

Maree Formation: Kurrillina 5/572/1 (Ludbrook, 1966).

Age: Early late Albian.

Labeceras papulatum Whitehouse, 1926

Pl.2, figs 3-5

Synonymy:

1926 *Labeceras papulatum* Whitehouse, p.226, 228, pl. 36, fig.4; pl.39, figs 3a-b.

1964a *Labeceras* (*Labeceras*) *laqueum* (Etheridge Jnr); Reyment, p.22, pl.1, fig.1.

1964a *Labeceras* (*Labeceras*) *crassum* Spath; Reyment, p.23, pl.1, fig.2.

1964b *Labeceras crassum* Spath; Reyment, p.37, pl.1, fig.5; pl.2, fig. 2a-b.

Type: Holotype: C25355 BM (NH). Locality: "Longreach," probably from Allaru Mudstone, lower upper Albian.

Material: Eight portions of shaft and hook.

Specific diagnosis: *Labeceras* with fine closely spaced ribs; large umbilical tubercles on hook; tubercles bundle ribs of reduced size into groups of 2-4; whorl section of shaft subelliptical; whorl section of hook subcircular or subquadrate.

Description: Medium sized. Only shaft and hook preserved in this material. Whorl section of shaft subelliptical, more or less laterally compressed. Flanks flattened, convergent dorsally and ventrally. Whorl section of hook subcircular or subquadrate. Ribs thin, rather blunt, closely spaced, continuous across dorsum and venter. Ribs on shaft non-tuberculate, strongly prorsiridiate. Hook with strong umbilical tubercles that bundle ribs into groups of 2-4. Bundled ribs of reduced size. Ribs on hook more or less rectiradiate, about 2mm apart near aperture. Aperture obliquely facing shaft. Lappets well developed. Shaft septate to commencement of hook. Suture with broad stemmed, shallowly bifid saddles and narrow, trifid lobes.

Dimensions:	Whorl height (WH)	Whorl thickness (WT)
CPC 9261 (aperture	c.15mm	c.15mm
(shaft	10mm	8mm
ANU 17904 (aperture	c.22mm	25mm
(shaft	13mm	12mm

Remarks: Labeceras papulatum Whitehouse (1926, p.228, pl.36, fig.4; pl.39, figs 3a-b) closely resembles Labeceras laqueum (Etheridge Jnr, 1892, p.496, pl.42, figs 14-15) (1909, pl.49, fig.4) in whorl section, but the latter species is apparently non-tuberculate. Reyment (1964a, p.22) thought that the presence or absence of tubercles was largely a function of preservation.

He placed Labeceras papulatum in synonymy with L. laqueum. However, the two are separated pending a close examination of the holotype of L. laqueum, which has not been illustrated photographically. The holotype of Labeceras laqueum should be in the collections of the Queensland Museum, but the writer has been unable to locate the specimen there. In the present material umbilical tubercles are uniformly developed.

The umbilical tubercles of Labeceras trifidum Whitehouse (1926, p.228) are much stronger than those of L. papulatum and the bundled ribs are not reduced in size.

Labeceras plasticum Spath (1925, p.191, pl.31, figs 4, 5, 8) originally described from equivalents of the varicosum and aequitoriale Zones (early late Albian) in Mozambique appears to be related to L. papulatum. A direct comparison of the Australian and Mozambique material would be considerable interest. Labeceras plasticum also occurs in early late Albian sediments in Zululand (Besaire, 1930, pl.65, fig.10) (Venzo, 1936, p.114) and Madagascar (Collignon, 1963, p.47, pl.258, fig.1125).

Occurrence:

Allaru Mudstone: "Longreach" (Whitehouse, 1926); Tributary of Brutus Creek about 1 mile S.E. of "Currane" (grid ref. 260083 Longreach); GAB1603; GAB1604.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

Age: Early late Albian.

Labeceras trifidum Whitehouse, 1926

Pl.3, figs 1-2

Synonymy:

1892 Crioceras sp. Etheridge Jnr, p.502, pl.33, fig.4.

1909 Crioceras laqueus Etheridge Jnr, pl.49, figs 7,9 only.

1926 Labeceras trifidum Whitehouse, p.228.

1958 Labeceras trifidum Whitehouse; Glaessner, p.218, pl.26, figs 4a-c.

Type: Holotype: F1382 GSQ. Locality: "15 miles S.W. of Hughenden," Allaru Mudstone, lower upper Albian.

Material: A single hook.

Specific diagnosis: Labeceras with very large umbilical tubercles on hook; umbilical tubercles bundle ribs of normal size into groups of 2-5; whorl section of hook elliptical, laterally compressed.

Description: Only a single, medium sized, rather crushed hook represented in this material. Whorl section apparently elliptical, laterally compressed. Ribs thin and sharp near dorsum, thick and rather blunt on venter, gently flexed. 3 strong umbilical tubercles bundle ribs of normal size into groups of 3 and 5. Non-tuberculate ribs bifurcating near umbilical rim, about 2mm apart on mid-flank. Bundled ribs about 1mm apart on mid-flank. Suture not preserved.

Dimensions:

	Whorl height (WH)	Whorl thickness (WT)
Holotype F1382 GSQ (smaller end of hook	15mm	c.10mm

	(larger end of hook	20mm	16mm
CPC 9234	(smaller end of hook	14mm	-
	(larger end of hook	15mm+	-

Remarks: The holotype of Labeceras trifidum Whitehouse (1926, p.228), a hook (F1382 GSQ) figured by Etheridge Jnr (1909, pl.49, fig.9) as Crioceras laqueus, has a unique pair of ventro-lateral tubercles. They are not developed in the solitary hook (CPC9234) occurring in the present collection. The distinction of L. trifidum from L. papulatum Whitehouse was discussed in the preceeding section.

Labeceras trifidum Whitehouse closely resembles L. plasticum var crassum Spath (1925, p.192, pl.31, figs 3,9; pl.34, figs 5-7) from early late Albian sediments in Mozambique. Reyment's (1964a, p.23) treatment of the two species as conspecific may be correct, although his action based solely on the published illustrations of Spath seems premature. A very similar form was also figured from Zululand by Venzo (1936, p.115, pl.9, fig.7) as Labeceras laqueum (Etheridge Jnr).

Glaessner (1958, p.218, pl.26, figs 4a-c) described specimens of Labeceras trifidum from New Guinea. In Australia, the species is known from the Wooldridge Limestone Member of South Australia (Reyment, 1964a) and from near the middle of the Allaru Mudstone.

Occurrence:

Allaru Mudstone: "15 miles southwest of Hughenden" (Whitehouse, 1926); GAB2019.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

New Guinea: (Glaessner, 1958).

Age: Early late Albian.

Indeterminate species of *Labeceras*

Remarks: Specifically indeterminate specimens of *Labeceras* occur in the Toolebuc Limestone at GAB803, GAB1002, GAB1005 and GAB1014; the Allaru Mudstone at GAB821, GAB1041, GAB1201, GAB1221, GAB2018, GAB2028, GAB2049, GAB2052, A.A.O. Penrith 1 (Core 3 1600' - 1610'), B.M.R. Longreach 2 (101'11" - 104'6"), B.M.R. Longreach 4 (224'2" - 224'3"); and the Mackunda Formation at GAB814, GAB834, GAB930, and GAB1403.

Genus *Appurdiceras* Whitehouse, 1926

Type species (by original designation): *Ancyloceras cordycepoides* Etheridge Jnr, 1905, lower upper Albian, South Australia.

Generic diagnosis: Small to medium sized. Initial crioceratid coil, curved septate shaft, and hook as in *Labeceras*. Aperture obliquely facing shaft, Lappets well developed. Whorl section subelliptical to subquadrate. Ribs fine or coarse, close or relatively distant. Ventro-lateral tubercles strong, present on initial coil, shaft, and hook. No umbilical tubercles. Suture with broad, shallowly bifid saddles and narrow trifid lobes.

Range: Lower upper Albian.

Remarks: Wright (1957a, p.L232) considered *Appurdiceras* Whitehouse (1926) a subgenus of *Labeceras* Spath (1925). This seems to be a somewhat arbitrary treatment as *Appurdiceras* is morphologically intermediate between *Labeceras* and *Myloceras*. The writer prefers a generic separation of the three forms.

Appurdiceras is closely related to *Labeceras*, but the former is readily distinguished by its strong ventro-lateral tubercles and the absence of umbilical tubercles. *Myloceras* resembles *Appurdiceras* in ventro-lateral tuberculation and small fragments of the two genera may be confused. In species of *Myloceras* with ancyloceratid coiling the aperture is not directed towards the shaft, which is non-septate. In species of *Appurdiceras* the aperture obliquely faces a septate shaft. Whitehouse (1926) included in the genus *Appurdiceras* the English species *Hamites spiniger* J. Sowerby, and doubtfully, *H. alternatus* Mantell, Spath (1939, p.579, 600) subsequently rejected this relationship. At present occurrences of *Appurdiceras* are confined to Australia. Specimens of the genus are known from the Toolebuc Limestone, Allaru Mudstone, and the Mackunda Formation.

Appurdiceras etheridgei Whitehouse, 1926

Pl.1, figs 2-3

Synonymy:

1926 *Appurdiceras* (?) *etheridgei* Whitehouse, p.230, pl.38, figs 2a-b.

Type: Holtoype: P15280 NMV. Locality: "Kensington, W. Qld, "Allaru Mudstone, lower upper Albian.

Material: Two portions of shaft and hook and an external mould of an initial coil with most of shaft preserved.

Specific diagnosis: *Appurdiceras* with a laterally compressed, subelliptical whorl section and small, periodic ventro-lateral tubercles.

Description: Medium sized. Only one volution of initial coil preserved in this material. Initial part of first whorl well separated from later formed parts; planispiral. Entire whorl section not determinable in this material; whorl section depressed at first, later elevated, laterally compressed and subelliptical on shaft. Ribs on earliest part of initial coil weakly elevated, blunt, rectiradiate, non-tuberculate, about 8 per 5mm on mid flank. Ribs on later parts of initial coil rectiradiate or slightly prorsiradiate; about 1mm apart on mid-flank; occasionally bifurcating; thickened across venter; periodically bearing small ventro-lateral tubercles. Tuberculate ribs separated by 2-3 non-tuberculate ribs. Ribs on shaft strongly prorsiradiate, becoming more widely separated; about 2mm apart on mid-flank; occasionally bifurcating at well developed ventro-lateral tubercles. Tuberculate ribs separated by 1-2 non-tuberculate ribs. Hook with strong, well elevated, commonly bifurcating ribs; rectiradiate near dorsum, rursiradiate near venter. Hook with ventro-lateral tubercles but no umbilical tubercles. Aperture obliquely facing shaft. Lappets well developed. Last septum at commencement of hook. Suture with broad stemmed, shallowly bifid saddles and narrow trifid lobes.

Dimensions:	Diameter of initial coil (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype P15280 NMV (smaller				
end of shaft	-	7mm	5mm	
(larger end of shaft	-	13mm	10mm	-
aperture	-	15mm	13mm	-
CPC9895 (initial coil	22mm	44%	-	41%
(smaller end of shaft	-	9mm	-	-
(larger end of shaft	-	11+mm	-	-
CPC 9894 (smaller end of shaft	-	13mm	-	-
(larger end of shaft	-	16mm	-	-
(aperture	-	20mm	-	-

Remarks: Three incomplete specimens in the present collections resemble the holotype of Appurdiceras etheridgei (P15280 NMV), a well preserved shaft and hook, described from "Kensington, W. Qld" by Whitehouse (1926, p.230, pl. 38, figs 2a-b). Whitehouse thought that only the shaft and hook were tuberculate but one of the present specimens (CPC9895) has ventro-lateral tubercles on the later parts of the initial coil.

Appurdiceras etheridgei appears to be closely related to the type species of Appurdiceras, Ancyloceras cordycepoides Etheridge Jnr

(1905, p.14, pl.1, figs 3-5; pl.2, fig.4) from "Dalhousie Springs" in South Australia. Thus the writer does not share Whitehouse's reservation concerning the generic identification of this species. Judging from Etheridge Jnr's illustrations, the South Australian form differs from A. etheridgei in its coarser ribbing, stronger tubercles and subcircular to subquadrate whorl section.

Occurrence:

Toolebuc Limestone: GAB951

Allaru Mudstone: "Kensington, W. Qld" (Whitehouse, 1926); GAB882; GAB2063.

Age: Early late Albian.

Indeterminate species of Appurdiceras

Remarks: Specifically indeterminate specimens of Appurdiceras occur in the Toolebuc Limestone at GAB803 and GAB2036, in the Allaru Mudstone at GAB1085 and GAB1228, and in the Mackunda Formation at GAB834 and Ju2.

Genus Myloceras Spath, 1925

Type species (by original designation Spath, 1925, p.193): "Myloceras ammonoides (Etheridge)" (= Crioceras ammonoides Etheridge Jnr, 1909), lower upper Albian, Queensland and South Australia.

Generic diagnosis: Generally large. Coiling ancyloceratid or crioceratid; initial coil circular or elliptical. Whorl section variable, circular, ellipsoidal, deltoid, rectangular or quadrate. Initial coil with fine, close ribbing and periodic, hemispherical ventro-lateral tubercles. Species with crioceratid coiling retaining essentially similar ornament on body chamber, with or without tubercles. Shaft and hook of most species with ancyloceratid coiling developing coarse, distant ribbing and large hemispherical or elongate-clavate ventro-lateral tubercles. Ribs commonly bundled in groups of 2 and 3 at tubercles. Suture with broad stemmed, bifid saddles and regularly trifid lobes.

Range: Upper middle - lower upper Albian.

Remarks: Spath (1925) employed Whitehouse's manuscript name *Myloceras* for three ammonite species from Portuguese East Africa, and selected "*Myloceras ammonoides* (Etheridge)" as type species. Whitehouse's description of *Myloceras*, with *Crioceras ammonoides* Etheridge Jnr (1909) designated type species, was not published until 1926.

Whitehouse (1926) also erected two new genera for related forms, *Aleteceras* (type species *Crioceras plectoides* Etheridge Jnr, 1909) and *Flindersites* (type species *Flindersites baccatus* Whitehouse, 1926). In Whitehouse's interpretation, *Myloceras* and *Aleteceras* comprised species with crioceratid coiling and fine close ribbing, the former including laterally compressed forms, the latter represented by species with a depressed whorl section. *Flindersites* accommodated the group of species with ancyloceratid coiling and coarse distant ribbing. However, such a subdivision does not withstand critical examination. *Myloceras davidi* Whitehouse closely approaches *M. ammonoides* (Etheridge Jnr) in ribbing, whorl section and tuberculation, but the former has

TEXT FIG.10

SUTURES OF SPECIES OF MYLOCERAS

A *Myloceras* cf. *axonoides* (Etheridge Jnr), ANU178905, suture at whorl height 74mm, X1; locality GAB1436, Coreena Member, Wallumbilla Formation, late early Albian.

B *Myloceras flindersi* (McCoy), CPC9829, suture at whorl height 70mm, X1; locality GAB836, Allaru Mudstone, early late Albian.

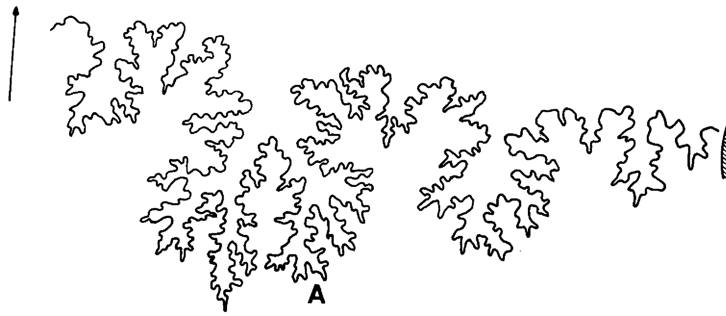
C *Myloceras nautiloides* (Etheridge Jnr), CPC9830, suture at whorl height 40mm, X1; locality 1612, same formation.

D *Myloceras baccatum* (Whitehouse),CPC9833, suture at whorl height 14mm, X1; locality GAB1605, same formation.

E *Myloceras davidi* Whitehouse, CPC9230, suture at whorl height 26mm, X1; locality GAB1610, same formation.

F *Myloceras ammonoides* (Etheridge Jnr), CPC9825, suture at whorl height 23mm, X1; locality GAB1394, same formation.

G *Myloceras intermedium* (Whitehouse), CPC9228, suture at whorl height 24mm, X1; locality GAB882, same formation.



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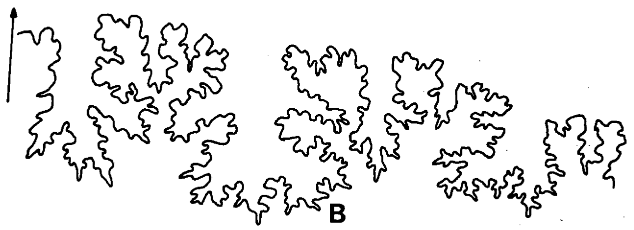

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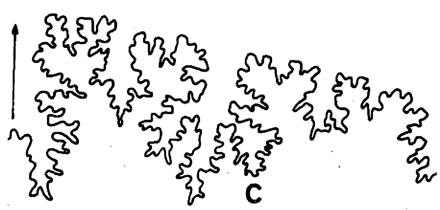

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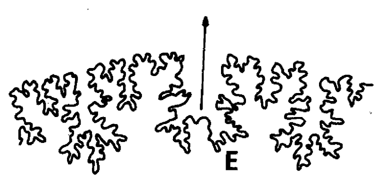

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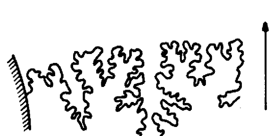
F



G

ancyloceratid coiling. Aleteceras plectoides (Etheridge Jnr) resembles Flindersites baccatus Whitehouse in these same features, although the former retains crioceratid coiling in the adult stage. Furthermore, a close examination of complete individuals shows that whorl section is rarely constant throughout life but varies considerably at different growth stages. During the present study, no combination of characters was found to be sufficiently constant to permit consistent supraspecific subdivision of the group. Spath (1939, p.601) previously concluded that Aleteceras and Flindersites were synonyms of Myloceras. This view was also adopted by Wright (1957a) and Reyment (1964a).

The monotypic Madagascan genera Ellipsoceras Collignon (1950, p.80) and Abadieceras Collingnon (1950, p.81) appear to be closely related to Myloceras, but are reported to be non-tuberculate. Ellipsoceras expansum Collignon (1950) and Abadieceras altissimum Collignon (1950) respectively resemble Myloceras davidi Whitehouse (1926) and M. ammonoides (Etheridge Jnr, 1909). Wright (1957a, p.L232) placed Abadieceras in synonymy with Ellipsoceras.

Myloceras is known only from Mozambique (Spath, 1925), Zululand (Besaire, 1930) (Venzo, 1936), Madagascar (Besaire, 1932) (Collignon, 1932, 1963), New Guinea (Glaessner, 1958) and Australia. In Mozambique and Zululand Myloceras occurs in association with European species including morteniceratids that allow direct correlation with the Mortoniceras inflatum Zone of the English Gault (the lowest zone of the standard upper Albian) (Spath, 1925)

(Venzo, 1936). In Madagascar, Myloceras is found with a similar fauna of European aspect and ranges through equivalents of the cristatum Subzone (topmost middle Albian) and the inflatum Zone (Collignon, 1963). Most of the Australian species of Myloceras occur near the middle part of the Allaru Mudstone. In the Tambo-Augathella area, they are associated with mortoniceratids that indicate a correlation with the lower subzones of the inflatum Zone of the English Gault. However, as noted in the section on overseas correlations, the total time range of Myloceras in Australia may exceed the cristatum - inflatum time interval, and may extend from the late early Albian to the late late Albian.

Eight species have been recognised in the present material. Most of these are represented by fragments that in toto display bewildering, apparently random variations in coiling, whorl section, ribbing and tuberculation. Although extreme variants such as Myloceras nautiloides (Etheridge Jnr) and Myloceras intermedium (Whitehouse) are readily distinguished from one another, all species appear to be connected by intermediate forms. The oldest species is a crioceratid, coiled form, Myloceras cf. axonoides (Etheridge Jnr) which occurs in the Coreena Member in the Aramac-Barcaldine area. Two small nucleii found near the top of the Ranmoor Member in the Richmond area may be representatives of Myloceras. The ancyloceratid coiled species Myloceras flindersi (McCoy), M. baccatum (Whitehouse) and M. intermedium (Whitehouse) occur near the base and near the middle of the Allaru Mudstone. However, the range of Myloceras flindersi may commence in the Toolebuc Limestone. Myloceras ammonoides (Etheridge Jnr), M. davidi (Whitehouse) and M. nautiloides (Etheridge Jnr) appear to be confined to the middle part of the Allaru Mudstone. Myloceras sp. occurs in the Mackunda Formation.

The superficially similar Aptian heteromorph Australiceras, which occurs in the Doncaster Member, is readily distinguished from Myloceras by the suture (Figs 9-10) and trituberculate nucleus of the former.

Myloceras ammonoides (Etheridge Jnr), 1909
Pl.1, fig.11; pl.5, fig.2; pl.6, fig.5;
text fig.10F

Synonymy:

1909 Crioceras ammonoides Etheridge Jnr, p.151, pl.49, figs 1-2.

1925 Myloceras ammonoides (Etheridge Jnr); Spath, p.193.

1926 Myloceras ammonoides (Etheridge Jnr); Whitehouse, p.234, pl.41, figs 2a-b.

1926 Myloceras orbiculus Whitehouse, p.235, pl.41, figs 1a-b.

1964a Myloceras ammonoides (Etheridge Jnr); Reyment, p.30.

1964b Myloceras ammonoides (Etheridge Jnr); Reyment, p.39, pl.1, figs 1a-b, 2a-b, 4; pl.2, figs 3-5.

Types: Crioceras ammonoides Etheridge Jnr. Holotype: F1397 GSQ. Locality: "Port Douglas" (Etheridge Jnr (1909, p.152) noted that this locality was probably incorrect).

Myloceras orbiculus Whitehouse. Holotype: AM collection (fide Whitehouse, 1926, p.235). Locality: "Beaconsfield", Allaru

Mudstone, lower upper Albian.

Material: Twelve well preserved specimens and numerous fragments possibly referrable to this species.

Specific diagnosis: Small to medium sized *Myloceras* with crioceratid coiling; whorl section elevated and laterally compressed; ribbing fine and dense; ventro-lateral tubercles small; body chamber non-tuberculate.

Description: Small to medium sized. Coiling crioceratid throughout; initial whorls slightly separated, later in contact. Whorl section at first subcircular, later elevated and laterally compressed. Flanks of later whorls flattened, subparallel. Venter narrow, gently arched. Dorsum narrow, almost flat. First whorl ornamented with thin, blunt, prorsiradiate ribs about 1mm apart on mid-flank; alternate ribs with small ventro-lateral tubercles. Ribs of second whorl about 2mm apart on mid-flank, occasionally bifurcating near umbilical rim with small, irregularly distributed ventro-lateral tubercles. Tuberculate ribs separated by 2-5 non-tuberculate ribs; sometimes bundled in pairs and bifurcating on venter. Ornament of body chamber non-tuberculate, essentially similar to that of early whorls; ribs about 4mm apart on mid-flank. Suture with broad stemmed, shallowly bifid saddles and deep, trifid lobes.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1397 GSQ	57mm	42%	23%	37%
CPC9229	50mm	42%	-	34%
CPC9825	60mm	45%	-	38%

Remarks: The writer is in agreement with Reyment (1964a, p.30), who placed Myloceras orbiculus Whitehouse (1926) in synonymy with M. ammonoides (Etheridge Jnr, 1909). The holotype of Myloceras orbiculus figured by Whitehouse (1926, pl.41, figs 1a-b) is a comparatively large form with crioceratid coiling. Evidence from this specimen and several less complete ones in the present collection suggests that Myloceras ammonoides retained regular crioceratid coiling and essentially the same ornament throughout life.

Myloceras ammonoides (Etheridge Jnr, 1909) may be confused with M. davidi Whitehouse (1926, p.235, pl.37, figs 2a-c) which has a similar whorl section and ribbing. Both occur in association in the middle part of the Allaru Mudstone. However, the initial coiling of latter species is ellipsoidal and the final body chamber develops as a shaft and hook.

The initial volutions of Myloceras intermedium Whitehouse (1926, p.237) also resemble those of M. ammonoides, although the sparsely ornamented shaft and hook of the former is highly distinctive.

Comparable overseas species include Myloceras besairei Collignon (1932, p.25, pl.3, figs 11-20, text figs 32-33) (1963, p.54, pl. 261, figs 1134-1135) and M. joffrei (Boule, Lemoine and Thevinen) as figured by Collignon (1932, p.25, pl.3, figs 21-35) (1963, p.52, pl.260, figs 1131-1132). Both species occur in the Zone of Hysteroceras binum (early late Albian) of Madagascar.

Abadieceras altissimum Collignon (1950, p.81, pl.14, fig.8, text fig.9) from the early late Albian of Madagascar also has coiling and fine ribbing like M. ammonoides (Etheridge Jnr) but appears to lack tubercles. The drawing of the whorl section (text fig.9) given by Collignon is very diagrammatic, but shows a change from a subcircular cross section in early whorls to a subrectangular section in later ones. This change in whorl section with growth is also evident in the Australian species.

Occurrence: "Port Douglas" ? (Etheridge Jnr 1909)

Allaru Mudstone: "Beaconsfield"; "W. side of Ward River, 23 miles S.W. of Tambo" (Whitehouse, 1926); GAB1085; GAB1394; GAB1416; GAB1605; GAB1610; GAB2063.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

Maree Formation: "Dalhousie Springs" (Whitehouse, 1926).

Age: Early late Albian.

Myloceras davidi Whitehouse, 1926

Pl.19, figs 1-3; text fig.10E

Synonymy:

1909 Crioceras sp. Etheridge Jnr, p.144, pl.38, figs 1-2.

1926 Myloceras davidi Whitehouse, p.235, pl.37, figs 2a,b,c.

1958 Myloceras davidi Whitehouse; Glaessner, p.217; pl.26, figs 2-3.

1964a Myloceras davidi Whitehouse; Reyment, p.30, pl.3, fig.4; pl.4, figs 1-4; pl.5, figs 3-4.

1964b Myloceras davidi Whitehouse; Reyment, p.38, pl.1, figs 3a,b; pl.2, fig. 1a,b.

1966 Myloceras davidi Whitehouse; Ludbrook, p.190.

Type: Holotype F1388 QM. Locality: "Bowen Downs, Thomson River", Allaru Mudstone, lower upper Albian.

Material: Ten incomplete specimens.

Specific diagnosis: Medium sized Myloceras with elliptical initial coiling; whorl section laterally compressed; ribbing fine and dense, bifurcating regularly on mid-flank; ornament of hook and shaft only slightly coarser than that of early whorls.

Description: Medium sized. Coiling ancyloceratid; initial coiling ellipsoidal with whorls separated or almost in contact; ultimate whorl with a long curved shaft and hook. Whorl section of initial volution subcircular; whorl section becoming subrectangular with growth. Body chamber laterally compressed, subrectangular in cross section. Flanks of later whorls flattened, subparallel, convergent ventrally. Venter narrow, gently arched. Dorsum narrow, almost flat. First whorl with thin, prorsiradiate or occasionally straight ribs about 1.5 mm apart on mid-flank; hemispherical ventro-lateral tubercles developed on almost every rib. Ribs of second whorl flexed, about 2-3mm apart on mid-flank;

small ribs not bundled at tubercles, passing straight across venter. Ornament of hook and shaft essentially similar to that of early whorls; final portion of hook with coarser ribs 3-4mm apart on mid-flank and large tubercles. Suture with broad stemmed, shallowly bifid saddles and deep, trifid lobes.

<u>Dimensions</u>:

	Diameter of initial coil (D)	Whorl height (WH)	Whorl thickness (WT)
Holotype F1388 QM (larger end of outer whorl	-	35mm	22mm
(smaller end of outer whorl	-	20mm	15mm
(larger end of inner whorl	-	12mm	9mm
(smaller end of inner whorl	-	7mm	6mm
CPC9230 (larger end of outer whorl	-	29mm	19mm
(smaller end of outer whorl	-	22mm	17mm
ANU17907	85mm	34mm	26mm

<u>Remarks</u>: The discrimination of <u>Myloceras</u> <u>davidi</u> Whitehouse (1926) from <u>M</u>. <u>ammonoides</u> (Etheridge Jnr) has been discussed in the preceding section.

<u>Ellipsoceras</u> <u>expansum</u> Collignon (1950, p.80, pl.14, figs 2-7) (1963, p.56, pl.262, fig.1136) from the Zone of "<u>Pervinquiera</u>" <u>inflata</u> (early late Albian) of Madagascar, approaches <u>M</u>. <u>davidi</u> in coiling, ribbing and whorl section, but the former

is reported to lack tubercles.

Myloceras mokarahense Collignon (1963, p.47, pl.258, fig. 1124) from the Zone of "Pervinquiera" inflata (early late Albian) of Madagascar, also resembles M. davidi.

Typical specimens of Myloceras davidi were described from New Guinea by Glaessner (1958) and from South Australia by Reyment (1964a-b). In Queensland, M. davidi occurs in the middle part of the Allaru Mudstone.

Occurrence:

Allaru Mudstone: "Bowen Downs, Thomson River"; "Sources of Barcoo, Ward and Nive Rivers" (Whitehouse, 1926); Brutus Ck about 1 mile SE of Currane (grid ref. 260083 Longreach 1:250,000 sheet); GAB1085; GAB1394; GAB1610.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

Maree Formation: Kurillina 5/572/1 (Ludbrook, 1966).

New Guinea: Glaessner (1958).

Age: Early late Albian.

Myloceras cf. axonoides (Etheridge Jnr), 1909

Pl.9, fig.1; pl.10, fig.4; pl.11, fig.1; text fig.10A

Synonymy:

cf. 1909 Crioceras axonoides Etheridge Jnr, p.150, pl.32, fig.4; pl.44, fig.1.

cf. 1926 Aleteceras (?) axonoides (Etheridge Jnr); Whitehouse, p.233.

Type: Holotype: Macleay Museum collection, University of Sydney (_fide_ Whitehouse, 1926, p.233). Locality: "Queensland".

Material: Two reasonably complete specimens and 8 portions of initial whorls and body chambers.

Description: Large. Coiling crioceratid, whorls well separated. Early whorls not well preserved in this material. Whorl section of first whorl subcircular; whorl section of later whorls elevated, deltoid. Flanks of earliest whorls gently convex; flanks of later whorls convex dorsally, flattened and convergent ventrally. Venter narrowly arched. Dorsum broad and flattened. Ribbing essentially similar throughout; ribs gradually becoming stronger and more widely spaced on later whorls. Ornament of first preserved whorl consisting of narrow, blunt, non-bifurcating straight and strongly prorsiradiate ribs, spaced about 4 per 5mm on mid-flank; large, hemispherical ventro-lateral tubercles developed mainly on alternate ribs, but sometimes occurring less frequently; non-tuberculate ribs thinner than tuberculate ribs. Ribs of second whorl 2-3mm apart on mid-flank, occasionally bifurcating, straight or slightly flexed, mostly rectiradiate; flank ribs bundled into groups of 2 or 3 at periodic, large, hemispherical, ventro-lateral tubercles; tuberculate ribs separated by 3-5 non-tuberculate ribs. Ribs of body chamber well elevated, thick, blunt, each rib tending to develop a pair of ventro-lateral nodes in lieu of tubercles; ribs generally flexed, rursiradiate near venter, occasionally bifurcating; on mid-flank ribs about 5mm apart at last septum (whorl height c. 75mm, whorl thickness c. 60mm), up to 15mm apart near aperture; ribs pass straight across venter without bifurcation. Suture with broad, bifid saddles and deep, trifid lobes, first lateral lobe with a large asymmetric, secondary saddle.

Dimensions:

	Maximum diameter	Diameter measurements taken	Whorl height	Whorl thickness	Umbilicus
	(D)	(D')	(WH)	(WT)	(U)
ANU17905	340mm	-	33%	26%	47%
CPC9837	-	190mm	34%	30%	45%

Remarks: Judging from the figures and description, "Crioceras" axonoides Etheridge Jnr (1909, p.150, pl.32, fig.4; pl.44, fig.1) closely corresponds to the present specimens. Points of similarity include large size,loose crioceratid coiling, dense ribbing, strong ventro-lateral tubercles developed on early whorls but not on body chamber, suture with an asymmetric secondary saddle developed in the first lateral-lobe, and apparently deltoid whorl section, although this feature was not illustrated by Etheridge Jnr. The present specimens from the Coreena Member of the Aramac-Barcaldine area provide the oldest record of the genus Myloceras from the Eromanga Basin. They are not identified with Etheridge Jnr's species as I have not been able to compare them directly with the holotype. Whitehouse (1926, p.233) reported that the holotype from "Queensland" was housed in the Macleay Museum collection, University of Sydney, but I was unable to locate it during a brief visit to that institution. Whitehouse (1926, p.233) doubtfully referred "*Crioceras*" *axonoides* to his genus *Aleteceras* here considered to be a synonym of *Myloceras*.

South Australian specimens identified as *Myloceras axonoides* by Reyment (1964a, p.28, pl.3, fig.1) and Ludbrook (1966, p.190, pl.28, fig.1) probably belong to *M. baccatum*.

The deltoid whorl section of *Myloceras* cf. *axonoides* (Etheridge Jnr) is highly distinctive. *Myloceras nautiloides* (Etheridge Jnr, 1909, p.148, pl.45, figs 1-2) and *M. ammonoides* (Etheridge Jnr, 1909, p.151, pl.49, figs 1-2) both from the middle part of the Allaru Mudstone appear to be the closest relatives of *M.* cf. *axonoides*. All three species have crioceratid coiling and non-tuberculate body chambers, but *M. nautiloides* has a depressed ellipsoidal whorl section while that of *M. ammonoides* is laterally compressed.

Reyment (1964a, p.28) listed *Myloceras amaltheia* Spath (1925, p.194, pl.34, fig.2) from the early late Albian of Mozambique as a synonym of *M. axonoides* Etheridge Jnr. Spath's species is inadequately illustrated and is difficult to interpret. However, the single figure given by Spath portrays an initial coil with ribs and tubercles quite unlike those of *M. axonoides*.

Occurrence:

Coreena Member: GAB1389; GAB1390; GAB1406; GAB1436.

Age: Late early Albian.

Myloceras nautiloides (Etheridge Jnr), 1909

Pl.1, fig.4; pl.5, fig.1; text fig.10C

Synonymy:

1909 Crioceras nautiloides Etheridge Jnr, p.148, pl.45, figs 1-2, text fig.8.

1926 Aleteceras nautiloides (Etheridge Jnr); Whitehouse, p.233.

1964a Myloceras nautiloides (Etheridge Jnr); Reyment, p.26, pl.2, figs 1-2; text fig. 3.

Type: Holotype: F1392 GSQ. Locality: "Aramac", probably from Allaru Mudstone, lower upper Albian.

Material: One reasonably complete, medium sized individual and about 5 less complete specimens.

Specific diagnosis: Medium sized Myloceras with tight crioceratid coiling; whorl section depressed; ornament of adult stage essentially similar to that of juvenile stage; body chamber without tubercles.

Description: Medium sized. Coiling tight, crioceratid. Whorl section depressed, ellipsoidal; whorl thickness exceeding whorl height at all stages of growth. Flanks gently convex. Venter wide, strongly arched. Dorsum wide, flat or slightly concave. Ribbing dense, strong, sharp, essentially similar throughout. Ribs frequently bifurcating near mid-flank, straight, commonly rursiradiate, rarely flexed; on-mid flank approximately 6 ribs in 5mm on first whorl, 4-5 ribs in 5mm on second whorl, 2-3mm apart on third whorl and 3-5mm apart on body chamber. Strong, sometimes spinose, hemispherical ventro-lateral tubercles periodically developed on first three whorls; tuberculate ribs separated by 2-3 non-tuberculate ribs on first whorl and 3-4 ribs on later whorls; flank ribs bundled into pairs at ventro-lateral tubercles and trifurcating before passing straight across the venter. Body chamber without tubercles. Suture with very broad stemmed, bifid saddles and wide, trifid lobes.

Dimensions:	Maximum diameter (D)	Diameter measurements taken (D')	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1392 GSQ	190mm	-	45%	50%	33%
ANU17906	82mm	-	41%	55%	37%
	-	62mm	39%	57%	34%
	-	35mm	37%	54%	40%

Remarks: The combination of crioceratid coiling and depressed whorl section with thickness always considerably exceeding height, makes Myloceras nautiloides (Etheridge Jnr, 1909) a highly distinctive species. However, small fragments may be confused with species of Appurdiceras. Whitehouse (1926, p.233) referred the form to his genus Aleteceras. That genus was relegated to the synonymy of Myloceras Spath (1925), by Spath (1939), Wright (1957), and Reyment (1964a). The writer concurs with their view. In Queensland, Myloceras nautiloides has been found only near the middle of the Allaru Mudstone.

Myloceras plectoides (Etheridge Jnr, 1909, p.152, pl.33, fig. 2; pl. 46, fig. 1; pl. 47, figs 1-4) (Whitehouse, 1926, p.232, pl.40, figs 2a-c) (Reyment, 1964a, p.26, pl.2, fig.3; pl.5, figs 1-2) is closest to M. nautiloides, the former differing in its almost equidimensional whorl section. "Aleteceras" tardicostatum Whitehouse (1926, p.232, pl.40, figs 1a-c) differs in whorl section in the same manner. Reyment (1964a, p.26) is probably correct in regarding "A". tardicostatum as a synonym of Myloceras plectoides. Myloceras baccatum (Whitehouse, 1926, p.236) is probably connected to M. nautiloides (Etheridge Jnr) through forms like M. plectoides.

Occurrence:

Allaru Mudstone: "Aramac" (Etheridge Jnr, 1909); Tributary of Brutus Creek about 1 mile S.E. of "Currane" (grid ref. 260083 Longreach 1:250,000 sheet); GAB1394; GAB1612; GAB2028.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964).

Age: Early late Albian.

Myloceras baccatum (Whitehouse), 1926
Pl.1, fig.5; pl.10, figs 1-2; pl.11, figs 2-3;
pl.17, fig.1; pl.18, fig.3; text fig.10D

Synonymy:

1909 Crioceras flindersi (McCoy); Etheridge Jnr, pl.36, fig.2; pl.40, figs 3-4; pl.41, fig.3; pl.42, fig.2; pl.44, fig.2.

1926 Flindersites baccatus Whitehouse, p.236.

1926 Flindersites aff. baccatus Whitehouse, p.237.

1964a Myloceras baccatum (Whitehouse); Reyment, p.27, pl.2, fig.4.

1964a Myloceras axonoides (Etheridge Jnr); Reyment, p.28, pl.3, fig.1.

1966 Myloceras axonoides (Etheridge Jnr); Ludbrook, p.190, pl.28, fig.1.

Material: Two specimens with some of nucleus preserved and about 20 portions of shaft and outer whorl.

Specific diagnosis: Large Myloceras with ancyloceratid coiling; whorl section initially subcircular, later quadrate; ribbing on initial coil dense, sharp, mainly straight, with periodic large, hemispherical tubercles; ribbing on shaft distant, sharp, mainly straight with more frequently developed large hemispherical tubercles; ribs bundled into groups of 2 and 3 at tubercles.

Description: Large. Coiling ancyloceratid; nucleus with tight crioceratid coiling; shaft very long and straight; final hook not recognised in this material. Whorl section initially subcircular, later quadrate; whorl section of shaft becoming more elevated with increasing size. Flanks of early whorls gently convex, convergent dorsally and ventrally; flanks of later whorls flattened and shouldered. Venter wide, gently arched. Dorsum wide, more or less flattened throughout. Ribbing of early whorls not well preserved in this material. First whorl with narrow, sharp, straight ribs spaced about 3 per mm, each rib tending to develop a pair of small ventro-lateral tubercles. Ribbing of second whorl not observed. Ribs of third whorl narrow, sharp, closely spaced, 2mm apart on mid-flank, straight or gently flexed, occasionally bifurcating, rectiradiate or rursiradiate near ventral margin; ribs on flank and venter bundled into groups of 2 or 3 at large, hemispherical, ventro-lateral tubercles; tuberculate ribs separated by 6-9 non-tuberculate ribs; ribbing continuous across dorsum throughout. Ribs on shaft widely spaced, about 5mm apart at last septum, up to 10mm apart on distal end of shaft; ribs narrow, sharp, well elevated, straight or slightly flexed, occasionally bifurcating, mainly rectiradiate but sometimes prorsiradiate or rursiradiate; ribs on flank and venter bundled in pairs or threes at large hemispherical tubercles; tuberculate ribs usually separated by only one non-tuberculate rib. Suture with broad stemmed, bifid saddles and deep trifid lobes; last septum at beginning of shaft (whorl height and thickness 60-90mm).

Dimensions:		Diameter of initial coil (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1394 GSQ					
	(larger end of shaft	-	68mm	66mm	-
	(smaller end of "	-	48mm	56mm	-
CPC9834	initial coil	72mm	44%	44%	42%
CPC9835	(larger end of initial (coil	-	31mm	31mm	-
	(smaller end of (initial coil	-	21mm	20mm	-

Dimensions: (cont)

		Diameter of initial coil (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
CPC9833	(larger end of (initial coil	-	33mm	32mm	-
	(smaller end of (initial coil	-	22mm	23mm	-
CPC9892	(larger end of shaft	-	68mm	65mm	-
	(smaller end of shaft	-	50mm	50mm	-
CPC9836	(larger end of shaft	-	105mm	70mm+	-
	(smaller end of shaft	-	68mm	62mm	-

Remarks: Whitehouse (1926, p.236) in proposing this taxon designated it type species of his new genus Flindersites. That genus was placed in synonymy with Myloceras Spath (1925) by Spath (1938), Wright (1957), and Reyment (1964a). The writer concurs with their view.

The holotype of "Flindersites" baccatus (F1394 GSQ), figured as Crioceras flindersi by Etheridge Jnr (1909, pl.36, fig.2; pl.41, fig.3; pl.42, fig.2; pl.44, fig.2), is a straight shaft approximately 210mm in length. Specimens from GAB1928 near the base of the Allaru Mudstone in the Tambo area provide the first association of a shaft with a crioceratid coiled nucleus. Myloceras baccatum, as interpreted here, is a large species with ancyloceratid coiling, an initially subcircular whorl section that becomes quadrate, and periodic tubercles that bundle the normally straight ribs into groups of 2 or 3. The species includes the form figured by

Etheridge Jnr (1909, pl.40, figs 1-2) as Crioceras flindersi and called Flindersites aff. baccatus by Whitehouse (1926, p.237).

The Queensland and South Australian species Myloceras plectoides (Etheridge Jnr, 1909, p.152, pl.33, fig.2; pl.46, fig.1; pl.47, figs 1-4) (Whitehouse, 1926, p.232, pl.40, figs 2a-c) (Reyment, 1964a, p.26, pl.2, fig.3; pl.5, figs 1-2) and its probable synonym "Aleteceras" tardicostatum Whitehouse (1926, p.232, pl.40, figs 1a-c) are closely comparable in whorl section, ribbing and tuberculation, but apparently do not develop a shaft and hook in the adult stage.

Myloceras intermedium (Whitehouse, 1926) described below, is also related to M. baccatum. However, the former is readily distinguished by its more laterally compressed, rectangular whorl section, finer and denser ribbing on the initial coil, and by its strongly flexed ribs and elongated tubercles on the shaft and hook.

Myloceras flindersi (McCoy) described in a following section, is also similar to M. baccatum but is larger and has an elevated, elliptical cross section.

The most closely allied overseas species appears to be Myloceras cornucopia Spath (1925, p.193, pl.32, fig.14; pl.34, fig.1) from equivalents of the varicosum and aequitoriale Zones of the English Gault (early late Albian) in Mozambique and the Zone of "Pervinquieria" inflata (early late Albian)in

Madagascar (Collignon, 1963, p.56, pl.260, fig.1130). Myloceras amalatheia Spath (1925, p.194, pl.34, fig.2) which is associated with and probably related to M. cornucopia is also similar.

In Queensland, Myloceras baccatum has been found near the base and near the middle of the Allaru Mudstone. The species also occurs in South Australia (Reyment, 1964a).

Occurrence:

Allaru Mudstone: "Wellshot ?, Barcaldine"; "Saltern Creek"; "sources of the Barcoo, Ward and Nive Rivers, south central Queensland"; "W. bank of Ward R., 23 miles S.W. of Tambo" (Whitehouse, 1926); GAB1394; GAB1605; GAB1928; GAB2063; GAB2096.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964).

Maree Formation: Algebuckina 5/571/17 (Ludbrook, 1966).

Age: Early late Albian.

Myloceras intermedium (Whitehouse), 1926

Pl.4, figs 1-2; pl.5, fig.3; pl.10, fig.3; pl.17, fig.2; text fig.10G

Synonymy:

1909 Crioceras flindersi (McCoy); Etheridge Jnr, pl.40, figs 1-2 only.

1926 Flindersites intermedius Whitehouse, p.237.

1964a Myloceras intermedium (Whitehouse); Reyment, p.27, pl.1, fig.8.

Type: Holotype: F1260 QM. Locality: "Mt Cornish", Allaru Mudstone, lower upper Albian.

Material: Two reasonably complete specimens and about 10 portions of shaft and hook.

Specific diagnosis: Medium sized *Myloceras* with ancyloceratid coiling; whorl section of shaft and hook elevated and rectangular; ribbing on initial coil, fine, dense, gently flexed; shaft and hook with coarse widely spaced, strongly flexed ribs, bundled into groups of 2 and 3 at large, elongate, clavate tubercles.

Description: Medium sized. Coiling ancyloceratid; nucleus with regular crioceratid coiling. Whorl section of first whorl depressed; whorl section of later whorls progressively more elevated; becoming subrectangular. Whorl section of shaft and hook laterally compressed, rectangular. Flanks flattened, subparallel or slightly convergent ventrally. Dorsum and venter initially narrow, flat or gently convex; dorsum and venter of shaft and hook wide and flattened. Ribs on first whorl fine, straight, about 1mm apart, approximately every 5th rib bearing a small ventro-lateral tubercle. Ribs of second whorl fine, about 2mm apart on mid-flank, bifurcating regularly, with irregularly distributed ventro-lateral tubercles; ribs sometimes bundled at large ventro-lateral tubercles. Ribs on shaft and hook strong, narrow, highly flexed, regularly bifurcating, 5-8mm apart on mid-flank, regularly bundled into groups of 2 and 3 at large elongate clavate tubercles. Septate to commencement of shaft. Suture with broad stemmed saddles and narrow deeply trifid lobes.

Dimensions:		Diameter of initial coil (D)	Diameter measurements taken (D')	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1260 QM		(90mm	-	36%	33%	43%
	(initial coil	(-	60	42%	-	42%
	(larger end of (shaft	-	-	45mm	40mm	-
	(smaller end of (shaft	-	-	40mm	36mm	-
CPC9228	(initial coil	(58mm	-	45%	29%	33%
		(-	34mm	44%	-	35%
	(larger end of (shaft	-	-	50mm	24mm	-
	(smaller end of (shaft	-	-	46mm	22mm	-
CPC9893	(larger end of (hook	-	-	60mm	46mm	-
	(smaller end of (hook	-	-	55mm	-	-

Remarks: Whitehouse (1926, p.237) proposed this taxon as a species of *Flindersites*, a genus regarded by Spath (1939), Wright (1957), Reyment (1964a) and the writer, as a junior subjective synonym of *Myloceras* Spath (1925). *Myloceras intermedium* is a medium sized species characterized by ancyloceratid coiling, an initially elevated, subrectangular cross section that gradually becomes rectangular, and ornament that changes suddenly from fine, close ribbing on the initial coil to coarse, distant, highly flexed ribbing with large, elongate, ventro-lateral tubercles that bundle the ribs into pairs. The shaft of the best preserved specimen (CPC9228) in the present collections is more laterally compressed than that of the holotype (F1260 QM), but the feature is seen to vary widely in fragmentary specimens. There also appears to be considerable individual variation in the strength and spacing of ribs, but this is difficult to document in the present fragmentary material.

Portion of a shaft and hook (F1396 GSQ) figured by Etheridge Jnr (1909, pl.40, figs 5-6) as Crioceras flindersi (McCoy) and stated by Whitehouse (1926, p.237) to be closely connected with "Flindersites" intermedius has exceptionally elongated ventro-lateral tubercles that bundle the ribs into groups of three. It may represent an extreme variant of Myloceras intermedium.

Myloceras flindersi (McCoy) described below is closely related to M. intermedium (Whitehouse). The former differs in its larger size, more highly arched venter, generally straighter, less bundled ribs and its ventro-lateral tubercles are more irregular in shape, size and occurrence.

Myloceras serotinum, originally described by Spath (1925, p.192, pl.31, figs 1,2,10,11; pl.32, fig.2; pl.33, figs 1-2; pl.35, figs 1a-b) from equivalents of the varicosum and aequitoriale Zones of the English Gault (early late Albian) in Mozambique, is very similar to M. intermedium Whitehouse. The ornament of the Mozambique species varies in the same manner as that of the Australian form. Myloceras serotinum was subsequently described from early late Albian sediments in Zululand by Besaire (1930, pl.55, fig.8) and Venzo (1936, p.114, pl.10, figs 4,9), and from the topmost middle Albian (Dipoloceras cristatum Zone) of Madagascar by Besaire (1932, p.47, pl.5, fig.4) and Collignon (1963, p.56, pl.262, figs 1137-1138).

In Queensland, Myloceras intermedium has been found near the base and near the middle of the Allaru Mudstone. The species also occurs in South Australia (Reyment, 1964a).

Occurrence:

Allaru Mudstone: "Mt Cornish"; "Longreach" (Whitehouse, 1926); GAB882; GAB1231; GAB1394; GAB1928; GAB2053.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

Age: Early late Albian.

Myloceras flindersi (McCoy), 1867

Pl.15, fig.1; pl.16, figs 1-3; pl.18, figs 1-2;

Synonymy: text fig.10B

1867a Ancyloceras flindersi McCoy, p.356.

1909 Crioceras flindersi (McCoy); Etheridge Jnr, pl.39, figs 1-3; pl.43 ?

1926 Flindersites flindersi (McCoy); Whitehouse, p.237.

1926 Flindersites aff. flindersi (McCoy); Whitehouse, p.237.

1964a Myloceras flindersi (McCoy); Reyment, p.28, pl.3, figs 2-3; text figs 5-6.

Type: Holotype: P2186 NMV. Locality: "West bank of Flinders River at base of Walkers Table Mountain", probably from Allaru Mudstone, lower upper Albian.

Material: About 12 large fragments of shaft, 2 showing final hook and an external impression of a shaft and part of the last whorl of initial coil.

Specific diagnosis: Exceedingly large Myloceras; whorl section elevated, subelliptical; shaft and hook with coarse, widely spaced, straight or gently flexed ribs, with large clavate or hemispherical tubercles.

Description: Exceedingly large. Coiling ancyloceratid; only part of initial coil preserved as an external impression; shaft long and gently curved, exceeding 200mm in length. Complete whorl section not observed in any one specimen; whorl section of later whorls elevated subelliptical, apparently becoming more elevated with growth. Flanks flattened and subparallel or gently convex and convergent ventrally and dorsally. Venter wide, strongly arched. Dorsum wide, flattened or gently convex. Flank ribs observed on part of initial coil comparatively strong, narrow; straight or slightly flexed; occasionally bifurcating; widely and somewhat irregularly spaced, 2-4mm apart on mid-flank; some ribs with strong hemispherical ventro-lateral tubercles. Ribs developed before last septum strong, narrow; well elevated; gently flexed; commonly bifurcating; approximately 3-5mm apart on mid-flank; large hemispherical, sometimes clavate, ventro-tubercles developed on each or fourth or fifth rib; flank ribs bundled in pairs only at clavate tubercles, generally bifurcating before passing straight across the venter at large tubercles. Ribs developed after last septum high, thick, bluntly or sharply rounded; initially about 5mm apart on mid-flank, rapidly becoming more widely spaced, up to 15mm apart on final hook. Ribs generally straight or slightly rursiradiate at ventro-lateral tubercles, bundled in pairs only at clavate tubercles; each rib on shaft and hook with tendency to develop large hemispherical or clavate tubercles; ribs regularly bifurcating before passing straight across venter at clavate tubercles, irregularly bifurcating at hemispherical tubercles. Septate to commencement of shaft. Sutures closely crowded, with comparatively narrow stemmed very deeply bifid saddles and wide, shallowly trifid lobes.

Dimensions:		Whorl height (WH)	Whorl thickness (WT)
Holotype P2186 NMV	(larger end of shaft	115mm	-
	(		
	(smaller end of shaft	100mm	-
CPC9826	(larger end of shaft	102mm	-
	(		
	(smaller end of shaft	96mm	-
CPC9827	(hook	100mm	c.70mm (incomplete)
	(		
	(shaft	c.90mm	45mm + (crushed)
CPC9828	(last septum	80mm	c.60mm (incomplete)
	(		
	(shaft	c.90mm	-

Remarks: This species was briefly described but not illustrated by McCoy (1867a, p.356) as *Ancyloceras flindersi*. Subsequently, Etheridge Jnr (1909) redescribed the species as *Crioceras flindersi* and illustrated the holotype (pl.39, fig.1) (P2186 NMV) from the "west bank of Flinders River, at base of Walker's Table Mountains". Whitehouse (1926, p.237) referred *Ancyloceras flindersi* to his new genus *Flindersites* (here considered a synonym of *Myloceras*) and thought McCoy's species was represented only by the holotype. In addition, Whitehouse recognised six species in material figured by Etheridge Jnr (1905) (1909) as *Crioceras flindersi*. Two of these were formally named *Flindersites baccatus* and *F. intermedius*. Both were fully discussed in the preceding section..

The holotype (P2186 NMV) is about 205mm in length and comprises part of a large shaft only one side of which is preserved. It has been well figured in lateral view by Etheridge Jnr (1909, pl.39, fig.1). McCoy's type was probably found in the lower part of the Allaru Mudstone near Hughenden, but its exact locality is uncertain. More complete specimens of comparable size from the lower part of the Allaru Mudstone near Richmond (GAB836) form the basis of the present reinterpretation of McCoy's species.

Myloceras flindersi is a very large species known primarily from the shaft and parts of the hook, which bear very heavy, distant, more or less straight ribs. There is considerable variation in size and shape of ventro-lateral tubercles. In the present material, ventro-lateral tubercles range in size from small to large, and in shape, from hemispherical to clavate. The holotype and specimens figured by Etheridge Jnr (1909, pl.39, figs 2-3) represent the extreme variant with elongated tubercles. The complete hook may be represented by the specimen figured by Etheridge Jnr (1909, pl.43). The initial coil is incompletely known, although the preserved fragments suggest that the ribbing may resemble that of the specimen figured by Etheridge Jnr (1909, pl.41, fig.1) and described in the following section as *Myloceras* sp. No one specimen exhibits an entire whorl section, but the shaft and hook were clearly elevated and subelliptical in section, with the venter more arched than the dorsum.

The whorl section and tuberculation of the final body chamber of Myloceras flindersi (McCoy) is morphologically intermediate between that of Myloceras baccatum Whitehouse (1926) and M. intermedium Whitehouse (1926). Myloceras baccatum has an equidimensional, quadrate whorl section and the tubercles are consistently hemispherical. Myloceras intermedium has a laterally compressed, rectangular whorl section and consistently clavate tubercles. In Queensland, all three species occur near the base and near the middle of the Allaru Mudstone. At one locality (GAB1928) all three occur in association. Myloceras flindersi may also be represented in the underlying Toolebuc Limestone.

Glaessner (1958, p.217) reported large fragments from New Guinea as Myloceras cf. flindersi.

Occurrence:

Toolebuc Limestone: GAB1002?

Allaru Mudstone: "W. bank of Flinders R. at base of Walkers Table Mountains" (McCoy, 1867); "Flinders River" (Whitehouse, 1926); GAB836; GAB1928; GAB2063.

Wooldridge Limestone Member: "Fossil Creek" (Reyment, 1964a).

New Guinea: ? Glaessner (1958).

Age: Early late Albian.

Myloceras sp.

Pl.1, figs 6-10; text fig.10H

Synonymy:

1909 Crioceras flindersi (McCoy); Etheridge Jnr, pl.41, fig.1 only.

Material: Four small specimens.

Description: Small, largest specimen about 40mm diameter. Coiling crioceratid, tight. Whorl section initially depressed and subcircular; whorl section of later whorls elevated and subrectangular. Flanks of later whorls flattened. Dorsum and venter narrow, gently convex. Ribbing sparse, fine, narrow, sharp, straight or slightly flexed; occasionally bifurcating. Ribs of first whorl about 1mm apart on mid-flank. Ribs of second whorl 2-3mm apart on mid flank; strong hemispherical, ventro-lateral tubercles tend to develop on all ribs of initial whorl and on much of second whorl. Tuberculate ribs separated by one or more non-tuberculate ribs on third whorl. Suture with broad stemmed, bifid saddles and narrow, deep, trifid lobes.

Dimensions:		Maximum diameter (D)	Diameter measurements taken (D')	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
F1395 GSQ		(98mm	-	43%	-	41%
		(	28	39%	36%	43%
CPC9313		28mm	-	33%	-	50%
CPC9831		35mm	-	(34%	23%	46%
				(13mm	9mm	
CPC9832	(larger end			23mm	26mm	
	(smaller end			14mm	14mm	

Remarks: Four specimens in the present collections from the Mackunda Formation are considered to be conspecific with a form from "Whitewood Ridge, Sesbania" (Mackunda Formation, Manuka area) figured by Etheridge Jnr (1909, pl.41, fig.1). Etheridge Jnr's specimen (F1395 GSQ) is much larger, but the correspondence in ribbing density and tuberculation is very close.

Whitehouse (1926, p.237) thought that Etheridge Jnr's specimen was closely connected with his *Flindersites intermedius* (= *Myloceras intermedium*). However, that species has denser ribbing on early whorls. The Mackunda species may prove to be closely related to *Myloceras flindersi* (McCoy) when more is known of the early whorls of the latter species.

Occurrence:

Mackunda Formation: "Whitewood Ridge, Sesbania" (Etheridge Jnr, 1909); GAB673; GAB674; GAB764; GAB930.

Age: Early late Albian.

Indeterminate species of *Myloceras*

Remarks: Indeterminate species of *Myloceras* occur in the Allaru Mudstone at GAB770, GAB802, GAB1041, GAB1416, GAB1608, GAB2023, GAB2064, GAB2070, GAB2095, and GAB2096. In addition two small (15-25mm diameter) heteromorph ammonites from GAB1123 and GAB1127 in the topmost sediments of the Ranmoor Member may be representatives of the genus *Myloceras*.

Order AMMONITIDA Hyatt, 1889

Superfamily HAPLOCERATACEAE Zittel, 1884

Family Aconeceratidae Spath, 1923

Remarks: This family comprises flat or slightly convex, narrowly umbilicate, carinate oxycones, which are generally small. The test is thin, smooth, or bears falcate striae or ribs. Lappets and rostra may be present. The suture line has a more or less symmetrically trifid first lateral lobe, and bifid, frequently subphylloid saddles, with the first lateral saddle taller than the external one.

The morphology, relationships, and distribution of the Aconeceratidae were reviewed by Casey (1954, pp.267-269) (1961b, pp.119-122). He strongly advocated derivation of the group from the Jurassic Oppeliidae, and thought the aconeceratids were pelagic, open sea dwellers that only sometimes entered the neritic zone. The family ranges from the lower Hauterivian to the upper Albian.

Genus *Aconeceras* Hyatt, 1903

Type species (by monotypy): *Ammonites nisus* d'Orbigny, 1841, upper Aptian, France.

Generic diagnosis: Involute oxycones, with flattened or gently convex sides that narrow above to a hollow, microscopically serrated carina. Ventro-lateral shoulders indistinct or absent. Umbilicus with a low, steep wall, angular at the rim. Test almost smooth, or bearing sickleshaped, forwardly-inclined striae, or faint, flattened riblets. Suture line with narrow, trifid lateral lobes, tall first lateral saddle, and numerous auxiliary elements declining in regular series to the umbilicus.

Range: Upper Barremian - lower Albian.

Remarks: The genus *Aconeceras* was fully discussed by Casey (1961b, p.123), who gave its distribution as Eurpoe, Russia, Arctic Canada, North, South and East Africa, and Australia. *Aconeceras* seems to have been commonest and most widely distributed in the Aptian. Casey (1961b,p.129) documented occurrences of the genus in the lower Albian of England and Algeria. A further Albian occurrence was reported from basal sediments of the Ranmoor Member by Day (1965).

Aconeceras sp.

Pl.22, figs 1-2; pl.24, fig.2; pl.25, fig.3

Synonymy: 1965 *Aconeceras* sp. Day, p.419.

Material: About 20 small, rather crushed specimens.

Description: Small; rather crushed. Whorl section elevated, compressed. Venter with a high, faintly crenulate keel. Aperture of specimen from Doncaster Member with prominent lappets. Ornament consisting of fine, densely spaced, falcate riblets. Suture not observed in this material.

Dimensions:	Maximum diameter (D)	Whorl Height (WH)	Whorl Thickness (WT)	Umbilicus (U)
CPC9314	36mm	c.53%	-	c.14%
CPC9315	22mm	c.50%	-	c.12%
CPC9839	13mm	54%	c.15%	15%

Remarks: The present specimens have the characteristic high keeled venter of *Aconeceras* and are confidently referred to that genus, although the suture has not been observed.

A specimen found at GAB2089 close to the top of the Doncaster Member in the Augathella area does not appear to differ from those found in basal sediments of the Ranmoor Member in the Hughenden area. An association of Barremian-early Albian *Aconeceras* with Albian *Beudanticeras* at GAB668 in the latter area, dates basal sediments of the Ranmoor Member there as early Albian.

Aconeceras austronisoides Brunnschweiler (1959a, p.11, pl.1, figs 1a-b) from the Aptian-early Albian Windalia Radiolarite of the Carnarvon Basin of Western Australia appears to be the most similar Australian species. However, the preservation of the holotype (CPC2626) and only known specimen is little better than that of the present material.

Occurrence:

Doncaster Member: GAB2089

Ranmoor Member: GAB668; BMR Richmond 1 (89'6"-89'6½"; 91'3"-91'4").

Age: Late Aptian - early Albian.

Superfamily ACANTHOCERATACEAE Hyatt, 1900

Family Binneyitidae Reeside, 1927

Remarks: Members of this family are small, compressed, flat-sided forms, with little ornament and a peculiarly simplified suture. Cobban (1961) revised the Binneyitidae and listed its component genera as Binneyites Reeside, Borissjakoceras Arkangelsky and a new genus Johnsonites Cobban. Subsequently, Casey (1961b, p.119) and Wright (1963, p.603) included Falciferella Casey in the family. Both Casey and Wright suggested derivation of the Binneyitidae from the Aconeceratidae by way of Falciferella. Wright (1957a) gave the range of the Binneyitidae as upper Cenomanian-Coniacian. Cobban (1961) extended the upper range limit into the lower Santonian. The inclusion of Falciferella extends the lower range limit into the middle Albian.

Genus Falciferella Casey, 1954

Type species (by original designation): Falciferella milbournei Casey, 1954, middle Albian (Hoplites dentatus Zone), England.

Generic diagnosis: Small platycones, with a narrow, sharp-rimmed umbilicus. Venter tabulate, feebly carinate in early youth. Ornament comprising strongly falcate riblets and growth lines, and a faint spiral groove on the mid-flank. Mouth border plain. Suture of simplified Aconeceras pattern, with reduced auxiliary elements.

Range: Middle - upper Albian.

Remarks: Casey (1954, p.273) tentatively referred

Falciferella to the Aconeceratidae. Subsequently, he (1961b, p.119) and Wright (1963, p.603) assigned it to the Binneyitidae. The genus is known from the type species _Falciferella milbournei_ Casey (1954) from the middle Albian of southern England, and _F. breadeni_ Brunnschweiler (1959a) and _F. reymenti_ (Brunnschweiler (1959a) from the lower upper Albian of South Australia.

Falciferella sp.

Pl.22, figs 4-9

Material: About 50 small specimens.

Description: Small; maximum observed diameter approx. 30mm. Involute, involution increasing in later whorls. Umbilicus small, steep sided. Whorls elevated and compressed. Flanks flat and parallel. Venter broadly arched throughout; no keel. Ornament consisting of fine, strongly falcate, densely spaced riblets and finer growth lines; riblets strongest ventro-laterally; riblets of later whorls tend to develop ventro-lateral nodes, then fade across the venter. Suture difficult to observe; saddles and lobes slightly indented; sides of saddles and lobes apparently smooth.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
CPC9381	25mm	50%	-	12%
CPC9823	7mm	50%	21%	21%
CPC9824	12mm	50%	-	17%
CPC9822	-	11mm	5mm	-

Remarks: Specimens designated *Falciferella* sp. are readily distinguished from those identified as *Aconeceras* sp. by their broadly arched, non-carinate venters. The best preserved material was found at GAB769 in the middle part of the Allaru Mudstone of the Julia Creek area. Specimens from the Toolebuc Limestone and the topmost beds of Ranmoor Member have less well preserved ornament and may not be conspecific.

The South Australian species *Falciferella breadeni* Brunnschweiler (1959a, p.15, pl.1, figs 5-6) and *F. reymenti* Brunnschweiler (1959a, p.16, pl.1, figs 7-8) from Santos Oodnadatta No.1 well at 245'2"-292'3" and 235'5" respectively, have simplified sutures like those of *Falciferella* sp. However, the ribs of the South Australian species weaken rather than strengthen ventrally.

Judging from the figured material, *Falciferella milbournei* Casey (1954, p.274, pl.7, figs 1-5, text. fig.3) from the *Hoplites dentatus* Zone (middle Albian) of England shows no tendency to develop ventro-lateral nodes on later whorls and the suture is more complex than that of *Falciferella* sp.

The simple suture and ventro-lateral nodes of *Falciferella* sp. ally that species to *Borissjakoceras orbiculatum* described by Stephenson (1955, p.64, pl.6, figs 1-5) from the Cenomanian of Texas, and by Cobban (1961, p.750, pl.88, figs 15-41; text fig. 5a-f) from Texas, Wyoming and Montana. Wright (1963, p.603) has previously noted a relationship between *Falciferella* and *Borissjakoceras*.

Occurrence:

Ranmoor Member: GAB1128?; GAB1144?

Toolebuc Limestone: GAB949?; GAB1014?; GAB2035?

Allaru Mudstone: GAB769; GAB821?; GAB1928; GAB2028; GAB2095; A.A.O. Penrith 1 (core 3 1600'-1610'); BMR Longreach 4 (209'8"-267'5").

Age: ? Early Albian - early late Albian.

Family Mortoniceratidae Spath, 1925

Remarks: This family includes moderately involute to very evolute shells, with a more or less rounded, square or compressed whorl section and a low to high keel. The ribs usually branch and are low and rounded, or flat to high and rounded, but never high and sharp. Umbilical tubercles occur and normally ventro-lateral tubercles in addition. The aperture has a forwardly, backwardly or upwardly directed rostrum. The suture generally has squarish, symmetrical, deeply and sharply indented saddles.

Mortoniceratids are exceedingly important in stratigraphic correlation and have been intensively studied. However, there is no general agreement on the nomenclature and scale of classification of the group, nor on the subdivision within it. The arrangement adopted here is that of Wright (1957a), but the group is assigned family rather than subfamily rank.

The family ranges from the middle Albian to the lower Cenomanian and was worldwide in distribution.

Genus *Prohysteroceras* Spath, 1921

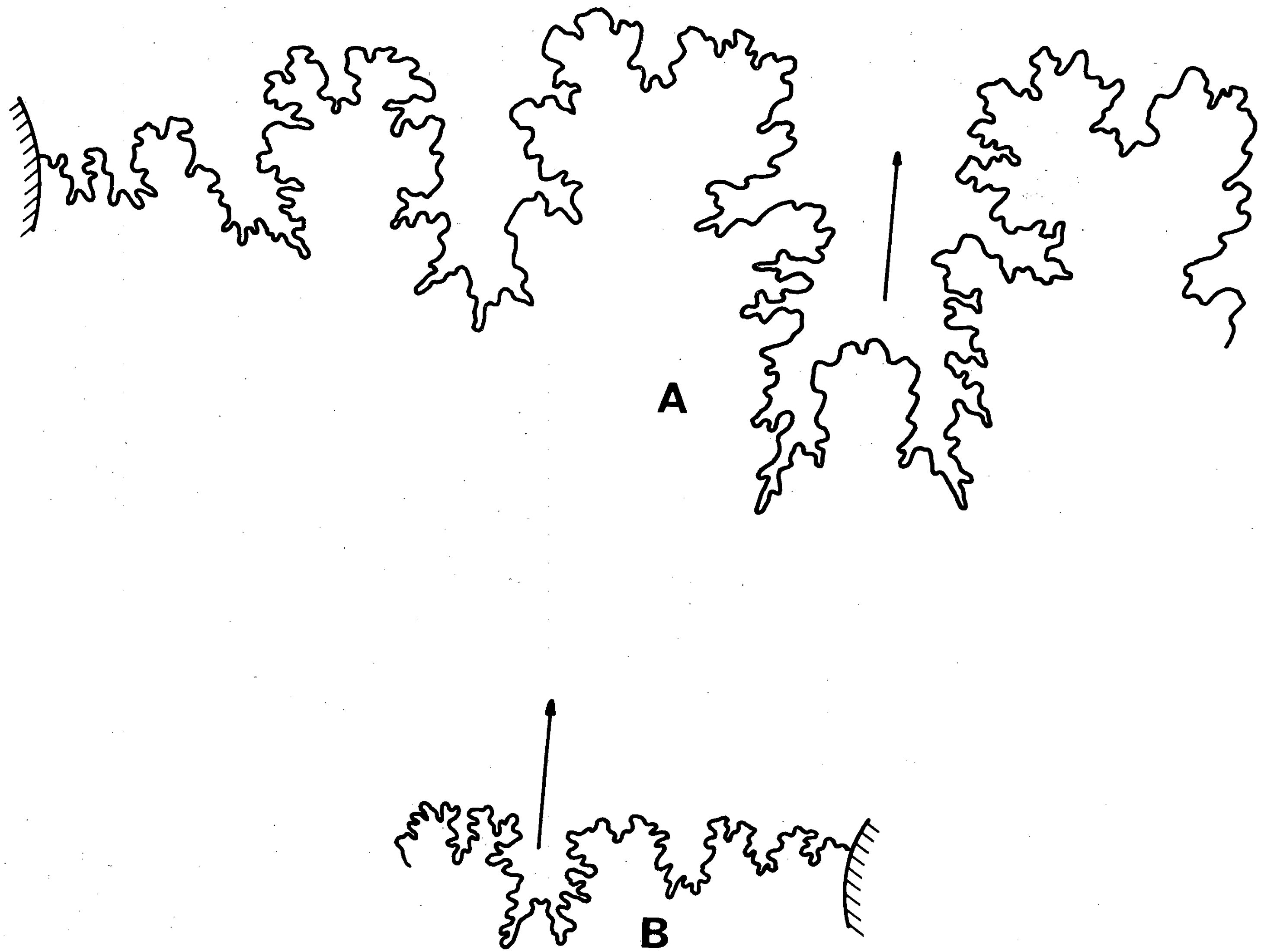
Type species (by original designation): *Prohysteroceras wordiei* Spath, 1921, lower upper Albian, Zululand.

Generic diagnosis: More or less evolute, compressed shells, with a high keel. Whorl section sometimes quadrate in young stages. Ribs rather weak, fine, close, sinuous and branching. Umbilical tubercles present but may be subdued in adult stages.

Range: Lower upper Albian.

Remarks: Spath (1933, p.442)(1934, pp.443-445) set out his ideas on the relationships of his nominate genus *Prohysteroceras* at some length. However, Young (1957, p.19) considered the genus and its affinities were still imperfectly understood.

TEXT FIG.11. Sutures of species of *Prohysteroceras*.
A *Prohysteroceras* cf. *angolaense* (Boule, Lemoine & Thevenin), CPC9493, suture at whorl height 57mm, X1; locality GAB2096, Allaru Mudstone, early late Albian.
B *Prohysteroceras* (*Goodhallites*) *richardsi* Whitehouse, CPC9312, suture at whorl height 20mm, X1; locality GAB2053, same formation.


A
B

Prohysteroceras is known from Texas (Young, 1957), Europe, Africa, Madagascar, Southern India and Queensland (Wright, 1957a).

The genus is never common in Queensland, and during the present study it was found only in the middle part of the Allaru Mudstone of the Tambo-Augathella area (south-eastern Eromanga Basin). Specimens used by Whitehouse (1926) and most of those of Etheridge Jnr (1892)(1909) were from this area. However, Etheridge Jnr (1892, pl.34, fig.4; pl.42, fig.12) also illustrated mortoniceratids from localities in the northern Eromanga Basin.

Comparatively few species have been referred to *Prohysteroceras* (*s.s.*). Neither *P. richardsi* Whitehouse nor *P.* cf. *angolaense* (Boule, Lemoine & Thévenin) belong to the genus in the restricted sense. The former is a representative of the subgenus *Goodhallites*; the latter is not readily accommodated in existing nominate taxa.

Prohysteroceras cf. *angolaense* (Boule, Lemoine & Thévenin) 1907

Pl.12, fig.1; pl.13, figs 1-2; pl.14, figs 1-2 pl.19, fig.4; pl.20, figs 1-2; text fig.11A

Synonymy:

1892 *Ammonites inflatus* (J. Sowerby); Etheridge Jnr, p.493, pl.34, figs 1-3; pl.42, fig.12?

1902 *Ammonites inflatus* (J. Sowerby); Etheridge Jnr and Dun, p.80 (*pars.*).

cf. 1907 *Schloenbachia inflata* var. *angolaensis* Boule, Lemoine & Thévenin, p.41, text fig.21.

1909 Schloenbachia rostratus (Sowerby); Etheridge Jnr, pl.65; pl.66, fig.1 only.

1926 Prohysteroceras angolaense (Boule, Lemoine & Thévenin); Whitehouse, p.223.

Material: About 20 incomplete specimens.

Description: Generally large. Unbilicus wide. Whorl section moderately inflated; more or less rectangular. Venter not shouldered, with a high keel. Ribs broad and high, widely spaced, almost straight on the flanks. Ribs generally bifurcating from strong umbilical tubercles. Ventro-lateral tubercles very large, especially in the adult stage. Suture with a deep ventral lobe and square, bifid saddles.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
CPC9492	65mm	43%	35%	35%
CPC9493	-	59mm	48mm	-
CPC9494	-	90mm	60mm	-
CPC9495	-	98mm	65mm	-

Remarks: Whitehouse (1926, p.223) considered that the Queensland specimens figured by Etheridge Jnr (1892)(1909) were conspecific with the form from Mont-Raynaud in Madagascar figured by Boule et al. (1907, p.41, text fig.21) as Schloenbachia inflata var. angolaensis. Though the tuberculation of the Madagascan and Queensland forms is remarkably similar, the writer is hesitant to accept Whitehouse's view, as the former is known only from a fragment of an outer whorl.

Spath (1934, p.447) remarked on the resemblance of the species to those of Deiradoceras van Hoepen (1931). However, whereas the ribbing of P. cf. angolaense approaches that of Deiradoceras, the whorl section accords more with that of Prohysteroceras.

Prohysteroceras cf. angolaense is only known with certainty from the middle part of the Allaru Mudstone in the Tambo-Augathella area of the south-eastern Eromanga Basin. A small individual (F1375GSQ) illustrated by Etheridge Jnr (1892, pl.42, fig.12) from "Warriana bore at a depth of 375 ft, 28 miles from Hughenden on the Winton road" may represent the species in the Northern Eromanga Basin. The stratigraphic horizon of Etheridge's specimen is also near the middle of the Allaru Mudstone.

Prohysteroceras richardsi var. nitidum Whitehouse (1926) figured by Etheridge Jnr (1909, pl.36, fig.3) has high ribs like those of P. cf. angolaense but is less tuberculate.

Occurrence:

Allaru Mudstone: "north-east end of Glanmire block, 17 miles S.W. of Tambo"; "Warriana bore at a depth of 375 ft, 28 miles from Hughenden on the Winton road" (Etheridge Jnr, 1892); "sources of the Barcoo, Ward and Nive Rivers, south central Queensland" (Etheridge Jnr, 1909); GAB2063; GAB2064?; GAB2096.

Age: Early late Albian.

Subgenus *Goodhallites* Spath, 1932

Type species (by original designation): *Ammonites goodhalli* J. Sowerby, 1820, lower upper Albian, England.

Subgeneric diagnosis: Keel prominent. Tuberculation frequently reduced. Ribbing fine in juvenile stage, sometimes stronger in adult stage.

Range: Lower upper Albian.

Remarks: Young (1957) assigned *Goodhallites* generic rank and listed *Cainoceras* van Hoepen (1942), *Letheceras* van Hoepen (1942), *Lethargeceras* van Hoepen (1942), and *Aidoceras* van Hoepen (1946) as synonyms. This treatment may be contrasted with that of Wright (1957a), who placed *Aidoceras* in synonymy with *Arestoceras* van Hoepen (1942), recognised *Cainoceras* with *Lethargeceras* as its doubtful synonym and *Letheceras* as its subgenus, and following Spath (1932)(1934), considered *Goodhallites* a subgenus of *Prohysteroceras*. Van Hoepen's taxa are difficult to evalute. They are excluded from consideration here as the present sparse material contributes little on the problem. *Prohysteroceras* and *Goodhallites* appear to be closely related and for the present the latter is regarded as a subgenus of the former.

Prohysteroceras (Goodhallites) richardsi Whitehouse, 1926

Pl.11, fig.4; pl.12, figs 2-3; text fig.11B

Synonymy:

1909 Schloenbachia rostratus (J. Sowerby); Etheridge Jnr, pl.67, fig.1 only.

1926 Prohysteroceras richardsi Whitehouse, p.222, pl.36, fig.2; pl.38, figs 1a-b.

1934 Prohysteroceras (Goodhallites) richardsi Whitehouse; Spath p.452.

Type: Holotype: F1784 QM. Locality: "Toliness", Augathella, Allaru Mudstone, lower upper Albian.

Material: Ten well preserved specimens.

Specific diagnosis: Medium sized Goodhallites with broad, rounded, closely spaced, slightly sigmoid ribs and inconspicuous umbilical and ventro-lateral tubercles.

Description: Medium sized. Moderately evolute; umbilicus fairly wide. Whorl section compressed, parallel sided. Venter flattened with a high keel. Ribs broad, rounded, closely spaced, slightly sigmoid. Ribs bifurcating at small, umbilical tubercles; ventro-lateral tubercles weakly developed. Suture with a deep ventral lobe and square, bifid saddles.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1784 QM	145mm	47%	28%	28%
CPC9312	80mm	44%	32%	27%

Remarks: Prohysteroceras (Goodhallites) richardsi Whitehouse bears a striking resemblance to the type species of Goodhallites, P. (G.) goodhalli (J. Sowerby) described by Spath (1934, p.447, pl.49, figs 3a-d; pl.50, fig.1; pl.51, figs 2a-b, 6a-b; pl.54, figs 2,10; pl.61, figs 6-9; text figs 153-155, 158a-b) from the orbignyi and auritus Subzones of the Gault of southern England. Indeed, Whitehouse (1926, p.222) considered that the Queensland species was represented in the Gault at Folkestone. Spath (1934, p.452) thought that P.(G.) richardsi could be separated from P.(G.) goodhalli, by the former's smaller first lateral lobe. The English species also displays stronger tuberculation.

Stratigraphically, P.(G.) richardsi occurs in the middle part of Allaru Mudstone of the Tambo-Augathella area. The close relationship existing between the English and Queensland species strongly supports an early late Albian age for that horizon.

Occurrence:

Allaru Mudstone: "Sources of the Barcoo, Ward, and Nive Rivers, south central Queensland" (Etheridge Jnr, 1909); "Toliness, Augathella" and "23 miles S.W. of Tambo (west bank of Ward River)" (Whitehouse, 1926); GAB2013?; GAB2053; GAB2096.

Age: Early late Albian.

Superfamily DESMOCERATACEAE Zittel, 1895

Family Desmoceratidae Zittel, 1895

Remarks: This family includes smooth to weakly ribbed shells with rounded, ovate, or lanceolate whorl sections. Constrictions are commonly developed. The suture pattern resembles that of the Phylloceratidae but the suture is foliate not phylloid.

Casey (1961b, p.141) has remarked upon the widely divergent views on the classification and phylogeny of the Desmoceratidae expressed by various authorities. He considered that this reflected the difficulty of dealing with large groups of relatively featureless shells which offer limited scope for detecting homeomorphy.

The oldest desmoceratid is the Valanginian genus *Eodesmoceras* Spath. The family was well represented, especially in Tethyan regions, until the close of the Maestrichtian when the entire subclass Ammonoidea became extinct.

Subfamily Pseudosaynellinae Casey, 1961

Remarks: Casey (1961b, p.169) proposed this subfamily to receive the Aptian genera *Pseudosaynella* Spath and *Aioloceras* Whitehouse (spelt *Ailoceras* by Casey). He interpreted the group as probable derivatives from Barremites, foreshadowing the Albian Cleoniceratinae in their tendency to oxyconic form.

Genus *Aioloceras* Whitehouse, 1926

Type species (by original designation): *Cleoniceras argentinum* Bonarelli, 1921, upper Aptian, Argentina.

Generic diagnosis: Platyconic with a narrowly arched venter. Inner whorls with sharp, non-tuberculate, falcate ribs. Later whorls smooth. Suture with bifid saddles, an irregularly trifid lateral lobe, and a number of accessory lobes and saddles.

Range: Upper Aptian.

Remarks: Whitehouse (1926, p.206) proposed this genus to accommodate the Queensland species Desmoceras jonesi Gregory & Smith (1903) and the Argentinian species described by Bonarelli (1921) as Cleoniceras argentinum, C. argentinum var. meseticum, Beudanticeras cf. stoliczkai (Kossmat) and Uhligella quercifolia (d'Orb).

Bonarelli (1921) assigned the Argentinian species an Albian age. However, Whitehouse considered them to be Aptian species as they underlay horizons with Sanmartinoceras (s.s.) which he regarded as a typical Aptian genus. Sanmartinoceras Bonarelli (1921) was assigned a Cenomanian age by its proposer. Evidence reviewed by Casey (1961b, p.132) conclusively shows that the genus, in a restricted sense, is confined to upper Aptian strata. The anomalous association of Aioloceras with Albian Beudanticeras reported from the Lake San Martin district by Bonarelli (1921) and Feruglio (1949) is discounted by Riccardi (pers. comm.). Specimens of Beudanticeras daintreei (Etheridge Snr) and B. cf. mitchelli (Etheridge Snr) described from the Lake San Martin area by Bonarelli (1921, pl.3, fig.5;

pl.4, fig.5) are not representatives of those Queensland forms, but are probably species of *Aioloceras*.

In the Tambo area specimens identified as *Aioloceras* cf. *jonesi* occur at approximately the same stratigraphic level as the late Aptian species *Tropaeum undatum* Whitehouse. The holotype of *Aioloceras jonesi* is poorly located, but is presumably from the late Aptian Blackdown Formation.

As noted by Casey (1961b, p.169) *Cleoniceras* (*Aioloceras*) *besairei* Collignon (1949, p.86, pl.18, figs 1-3; pl.21, fig.7; text fig.24) from the Albian of Madagascar is a species of *Cleoniceras* which has undergone secondary loss of tuberculation. Collignon (1963, p.88) subsequently referred his species to the subgenus *Paracleoniceras*. In summary, *Aioloceras* is known only from Queensland and Patagonia, and in both areas it is apparently confined to upper Aptian strata.

Aioloceras cf. *jonesi* (Gregory & Smith), 1903
Pl.22, fig.3; pl.24, fig.3; pl.25, fig.4; pl.26, fig.3; text fig.12

Synonymy:

cf. 1903 *Desmoceras jonesi* Gregory & Smith, p.142, pl.22, figs 1-2.

cf. 1926 *Aioloceras jonesi* (Gregory & Smith), Whitehouse, p.207.

Type: I have been unable to locate the holotype. *Locality*: "Mitchell River", probably from Blackdown Formation, upper Aptian.

Material: Five somewhat incomplete specimens preserved mainly as internal moulds.

Description: Medium to large sized. Discoidal; moderately evolute; umbilicus with gently sloping walls. Whorl section of earliest volutions well inflated, with a narrowly rounded venter; intermediate whorls oxyconic in section, with flanks flattened and convergent towards a sharp venter; whorl section of ultimate volutions more inflated, with gently convex flanks convergent towards a more rounded venter. Ornament not well preserved in this material. Early whorls with low, falcate, non-tuberculate ribs about 3mm apart; later whorls apparently smooth. Sutures closely crowded, sometimes touching; accessory saddles and lobes numerous; saddles comparatively broad stemmed, bifid; lobes irregularly trifid; ventral lobe very deep; ventral saddle high and narrow.

	Maximum Diameter	Diameter measurements taken	Whorl height	Whorl thickness	Umbilicus
Dimensions:	(D)	(D')	(WH)	(WT)	(U)
CPC9231	100	-	50%	21%	20%
CPC9232	-	(135mm+	73mm	33mm	20mm+
		(62mm+	32mm	18mm	12mm+
CPC9233 (larger end)	-	-	155mm	80mm	-
(smaller end)	-	-	125mm	65mm	-

Remarks: The nucleus of the holotype of Aioloceras jonesi figured by Gregory & Smith (1903, pl.22, fig.1) appears to have stronger ribs than those of specimens now compared with that species. The whorl section of the holotype was not illustrated. Unfortunately, I have been unable to locate the type specimen. Aioloceras jonesi remains a relatively poorly known species with a very meagre representation of 6 specimens.

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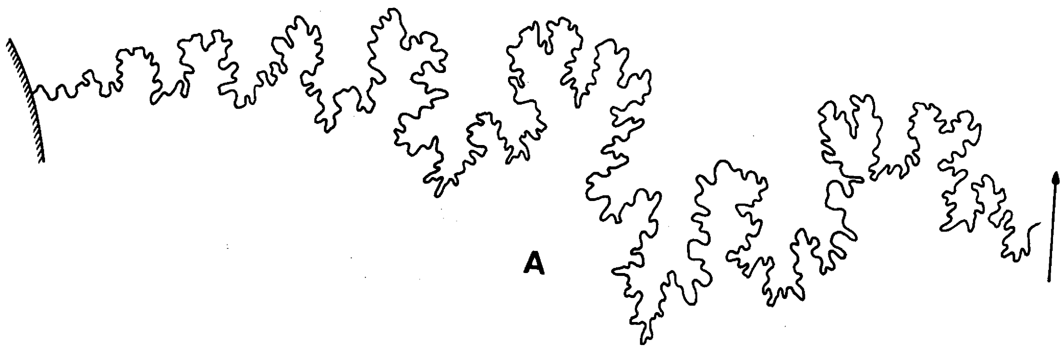
TEXT FIG.12

SUTURES OF AIOLOCERAS JONESI (GREGORY & SMITH)

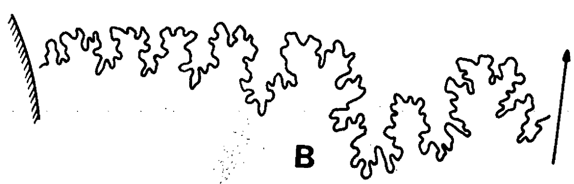
A CPC9233, suture at whorl height 100mm, X1; locality GAB2130, Doncaster Member, Wallumbilla Formation, late Aptian.

B CPC9232, suture at whorl height 70mm, X1; same locality.

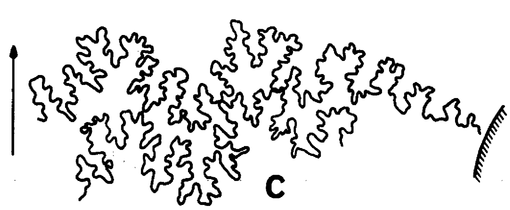
C CPC9231, sutures at whorl height 46mm, X1; same locality.



A



B



C

The type species of Aioloceras, Cleoniceras argentinum Bonarelli (1921, p.24, pl.4, fig. 6) (also described by Piatnizky, 1938, p.79, pl.3, figs 13a-b), and C. argentinum var. meseticum Bonarelli (1921, pl.4, fig. 7), both from the Lake San Martin area of Patagonia, are more involute, and have strong flank ribbing continued to later stage than A. jonesi. However, the suture line of A. argentinum is very similar to that of A. jonesi (Riccardi pers. comm.).

Other Argentinian species described by Bonarelli (1921) from the Lake San Martin district of Patagonia as Beudanticeras cf. stoliczkai Kossmat (pl.3 fig 1-4), and Uhligella quercifolia (d'Orb.) (pl.3, fig.6), and subsequently referred to Aioloceras by Whitehouse (1926, p.206), apparently differ from A. jonesi in having strongly ribbed, not smooth, later whorls. Specimens from the same area figured by Bonarelli (1921) as Beudanticeras daintreei (Etheridge Snr) (pl.3, fig.5) and Beudanticeras cf. mitchelli (Etheridge Snr) (pl.4, fig.5) are similar, and possibly should also be included in Aioloceras.

The Beudanticeras cf. stoliczkai Kossmat of Piatnizky (1938, p.79, pl.8, fig.38) may not be conspecific with the form figured under that name by Bonarelli (1921).

Occurrence:

Doncaster Member: GAB2130.

Blackdown Formation:? "Mitchell River" (Gregory & Smith, 1903).

Age: Late Aptian.

Subfamily Beudanticeratinae Breistroffer, 1953

Remarks: This subfamily comprises smooth or distinctly ribbed, compressed, high-whorled, rather involute shells with a narrow venter. Casey (1961b, p.144) included in the group Beudanticeras Hitzel, Zurcherella Casey, Uhligella Jacob, Cymahoplites Spath, Pseudorbulites Breistroffer, Brewericeras Casey, Cophinoceras Whitehouse (=Beudantiella Breistroffer), and Boliteceras Whitehouse. Jones et al. (1965) referred Leconteites Casey (1954) with Puzosigella Casey (1954) as its subjective synonym, to the subfamily Beudanticeratinae. Casey (1954) had placed these genera in the Hoplitidae. The subfamily ranges from the top of the Barremian to the top of the Albian.

Genus Beudanticeras Hitzel, 1905

Type species (by original designation): Ammonites beudanti Brongniart, upper Albian, France.

Generic diagnosis: Discoidal; high-whorled. Umbilicus fairly narrow. Flanks gently convex or flat. Venter narrowly rounded. Test ornamented with falciform or sigmoid growth striae; subdued costation sometimes developed; test frequently thickened by internal ridges reproduced as constrictions on the internal mould. Suture with bifid saddles and trifid lobes and numerous auxiliaries; first lateral lobe much deeper than the ventral lobe and with varying degrees of asymmetry.

Range: Albian.

Remarks: Whitehouse (1926, p.218) and later Casey (1949, p.343) suggested that Beudanticeras included smooth derivatives of Uhligella. The existence of morphological intermediates like Beudanticeras dupinianum (d'Orbigny) strongly support such proposals. However, Casey (1961, p.145) considered that it was uncertain whether Beudanticeras was a natural taxon or an assemblage of smooth end-forms of different desmoceratid stocks.

At present, Beudanticeras includes species possessing sutures with wide-stemmed saddles (e.g. the type species B. beudanti (Brongniart)) and forms with narrow-stemmed saddles (e.g. B. laevigatum (J. Sowerby)). Imlay (1961, p.56) erected a subgenus Grantziceras with the early Albian species Beudanticeras (Grantziceras) multiconstrictum Imlay (1960, p.105, pl.14, figs 1-2) (1961, p.56, pl.14, fig.1; pl.15, figs 1-12) from Alaska as type. He distinguished Grantziceras from typical Beudanticeras by its numerous, regularly spaced, falciform constrictions, bundled flank striae, and scaphitoid body chamber. While the importance of constrictions may be queried as a subgeneric taxobasis, Imlay's taxon may prove useful if extended to include well inflated, narrowly umbilicate species of Beudanticeras possessing simple sutures with broad stemmed saddles.

Beudanticeras is a commonly occurring, cosmopolitan genus. It characterizes Albian strata in many parts of the world.

TEXT FIG.13

SUTURES OF SPECIES OF BEUDANTICERAS

A "Beudanticeras" vinei sp. nov., paratype CPC9500, suture at whorl height 120mm, X1; locality GAB836, Allaru Mudstone, early late Albian.

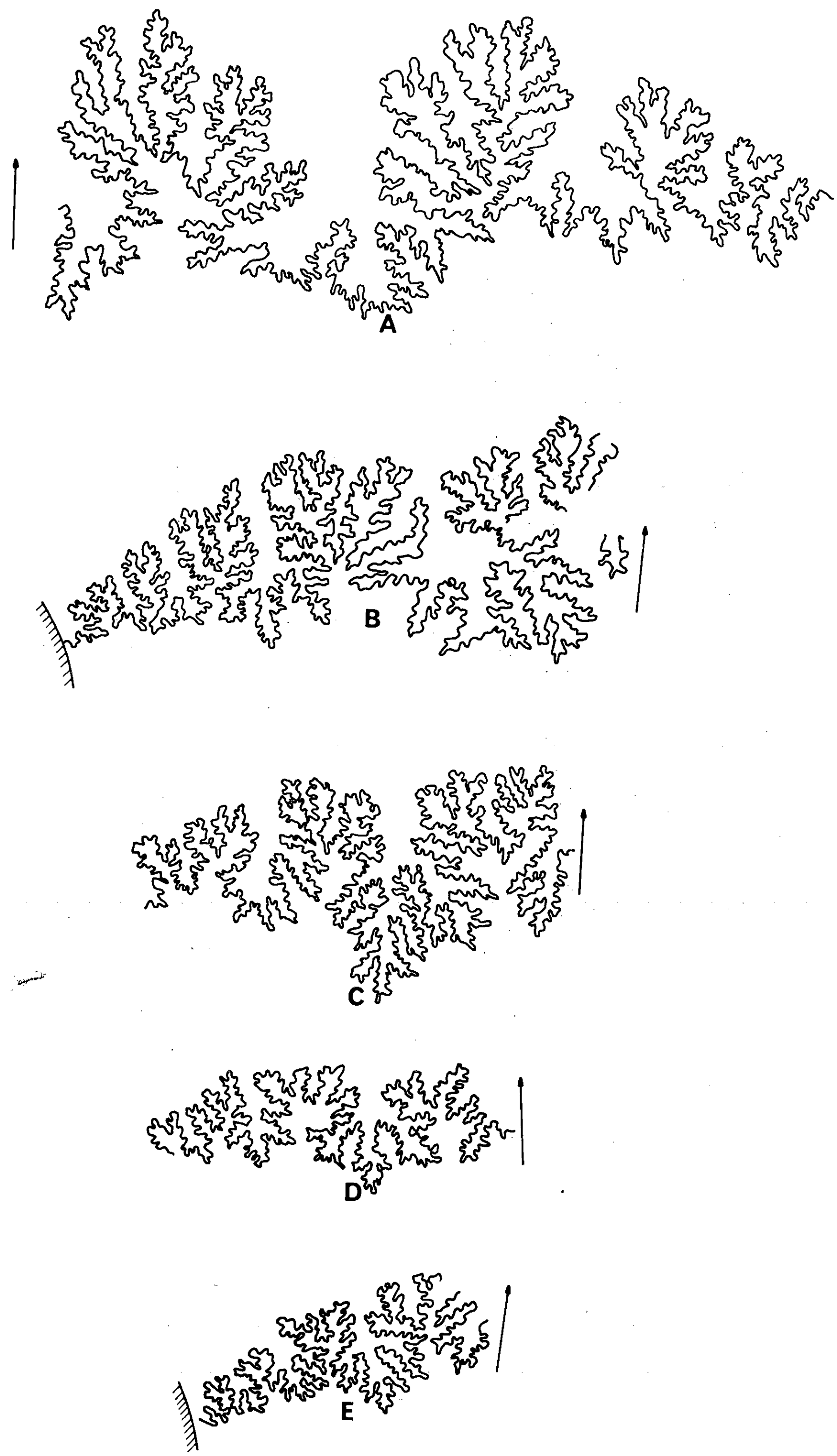
B Beudanticeras ingente Whitehouse, CPC9265, suture at whorl height 80mm, X1; locality GAB1085, same formation.

C Beudanticeras ingente Whitehouse, holotype F5616 GSQ, suture at whorl height 60mm, X1; locality "Beaconsfield", same formation.

D Beudanticeras flindersi (McCoy), CPC9263, suture at whorl height 54mm, X1; locality GAB1132, Ranmoor Member, Wallumbilla Formation, late early Albian.

E Beudanticeras flindersi (McCoy), CPC9496, suture at whorl height 40mm, X1; locality GAB668, lower Ranmoor Member, early early Albian.

F Beudanticeras sutherlandi (Etheridge Snr), holotype F1273 QM, suture at whorl height 22mm, "Marathon", Toolebuc Limestone, early late Albian.


A
B
C
D
E
F

Beudanticeras *flindersi* (McCoy), 1865

Pl.8, figs 2-6; text fig.13D,E

Synonymy:

1865 *Ammonites* *flindersi* McCoy, p.334.

1866 *Ammonites* *flindersi* McCoy, p.51.

1867b *Ammonites* *flindersi* McCoy, p.42.

1867c *Ammonites* *flindersi* McCoy, p.196.

1892 *Ammonites* *flindersi* McCoy; Etheridge Jnr, p.494 (*pars*.).

1902 *Haploceras* *flindersi* (McCoy); Etheridge Jnr and Dun, p.82 (*pars*.).

1926 *Beudanticeras* *flindersi* (McCoy); Whitehouse, p.219 (*pars*.).

1928a *Desmoceras* (?) sp. Whitehouse, p.200, pl.26, figs 1a-b.

1928a *Beudanticeras* *flindersi* (McCoy); Whitehouse, p.201, pl.25, fig.3.

1932 *Beudanticeras* *flindersi* (McCoy); Seitz, p.409, 410, 414.

1965 *Beudanticeras* *flindersi* (McCoy); Day, p.419.

Type: Holotype: P2185 NMV. Locality: "west bank Flinders River, at the base of Walker's Table Mountains", Ranmoor Member, lower-lower middle Albian.

Material: Four well preserved individuals and ten crushed specimens.

Specific diagnosis: Small to medium sized *Beudanticeras*; umbilicus with gently sloping sides; innermost whorls depressed; later whorls elevated, laterally compressed with convergent flanks; internal moulds without periodic constrictions; ornament subdued, consisting of very fine ribs and growth striae; suture with narrow stemmed, deeply bifid saddles.

Description: Small to medium sized. Discoidal; moderately involute. Umbilicus with gently sloping sides. Whorl section of initial volutions depressed; later volutions with elevated, laterally compressed whorl section. Flanks convergent ventrally. Venter narrowly rounded. Internal moulds without periodic constrictions. Ornament subdued, stronger on early whorls; ribbing very fine, closely spaced, slightly falciform; growth striae parallel ribs. Sutures closely crowded, with narrow stemmed, deeply bifid saddles and broad, trifid lobes.

Dimensions:	Maximum diameter (D)	Diameter measurements taken (D')	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
P2185 NMV	150mm	-	47%	23%	19%
CPC9496	110mm	-	49%	-	20%
CPC9263	205mm	-	-	-	-
	-	165mm	52%	23%	17%
	-	62mm	52%	32%	20%
	-	26mm	50%	35%	20%
CPC9264	25	-	56%	40%	20%

<u>Remarks</u>: Seitz (1932, p.414), after examination of Whitehouse's (1928a, pl.25, fig.3) illustration of the holotype of <u>Beudanticeras flindersi</u>, considered that the width of the umbilicus should be about 20% of the total diameter. Whitehouse (1928a, p.202) gave this dimension as 26% and 28%. I have measured the holotype (P2185 NMV) and the umbilicus comprises 19% of the total diameter.

The nucleus of <u>Beudanticeras flindersi</u> was figured by Whitehouse (1928a, pl.26, figs 1a-b) as <u>Desmoceras</u> ? sp. It is much more inflated than the adult stage.

Occurrences of <u>Beudanticeras flindersi</u> (McCoy) appear to be confined to the Ranmoor Member. In the uppermost parts of that unit the species occurs in association with <u>Beudanticeras sutherlandi</u> (Etheridge Snr). The latter may be distinguished by its smaller size, prominent periodic constrictions, and the wide stemmed saddles of its suture.

<u>Beudanticeras ingente</u> Whitehouse (1928a, p.202, pl.25, fig.1) from the Allaru Mudstone is more inflated than the <u>B. flindersi</u> and has a steep walled umbilicus.

<u>Occurrence</u>:

<u>Ranmoor Member</u>: "west bank of Flinders River, at the base of Walker's Table Mountains" (McCoy, 1865); GAB668; GAB1121; GAB1123; GAB1126; GAB1127; GAB1132.

<u>Age</u>: Early early - late early Albian.

<u>Beudanticeras</u> <u>sutherlandi</u> (Etheridge Snr), 1872

Pl.7, figs 1-4; text fig.13F

<u>Synonymy</u>:

1867b <u>Ammonites</u> <u>sutherlandi</u> McCoy, p.42 (<u>nom. nud</u>.).

1872 <u>Ammonites</u> <u>sutherlandi</u> Etheridge Snr, p.345, pl.21, fig.4.

1892 <u>Ammonites</u> <u>sutherlandi</u> McCoy M.S.; Etheridge Jnr, p.496.

1892 <u>Ammonites</u> <u>sutherlandi</u> Etheridge Snr; Etheridge Jnr, p.496, pl.29, fig.4.

1902 <u>Desmoceras</u> ? <u>sutherlandi</u> (Etheridge Snr); Etheridge Jnr and Dun, p.82.

1926 <u>Beudanticeras</u> ? <u>sutherlandi</u> (Etheridge Snr); Whitehouse, p.222.

1928a <u>Beudanticeras</u> <u>sutherlandi</u> (Etheridge Snr), Whitehouse, p.202, pl.25, fig.4.

1932 <u>Beudanticeras</u> ? <u>sutherlandi</u> Auct.; Seitz, p.413.

1932 <u>Beudanticeras</u> <u>sutherlandi</u> (Etheridge Snr); Seitz, p.414.

<u>Type</u>: <u>Holotype</u>: F1273 QM. <u>Locality</u>: "Marathon", Toolebuc Limestone, lower upper Albian.

<u>Material</u>: Three well preserved individuals and seven crushed specimens.

<u>Specific diagnosis</u>: Small, involute <u>Beudanticeras</u>; umbilicus narrow, with gently sloping sides; juvenile stage more inflated and more evolute than adult stage; flanks gently convex; internal moulds with numerous prominent constrictions; test bearing fine, falciform growth striae; suture with broad stemmed saddles.

Description: Small. Discoidal; involute. Umbilicus small, with gently sloping sides. Juvenile stage more inflated and more evolute than adult stage. Flanks gently convex. Venter broadly rounded. Internal moulds with numerous prominent constrictions. Test bearing fine, falciform, growth striae. Sutures closely crowded, with broad stemmed saddles and shallowly trifid lobes.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F1273 QM	70mm	50%	-	14%
CPC9497	40mm	50%	40%	20%

Remarks: McCoy (1867b, p.42) introduced Ammonites sutherlandi with the statement "a new small species like the French Am. Parandieri of the Gault". No illustration was provided. McCoy's species cannot be interpreted without reference to his type material and this is no longer extant in collections of the National Museum of Victoria. McCoy's name should thus be set aside. This course avoids the need to rename the well established nominate species Ammonites sutherlandi Etheridge Snr (1872, p.342, pl.21, fig.4).

The simple, wide stemmed saddles of Beudanticeras sutherlandi ally that species to the European B. laevigatum (J. Sowerby) as figured by Spath (1923, pl.3, figs 2a-d; text fig.13) and Casey (1961b, pl.28, figs 6a-b; text fig. 49a-f). The latter species is distinguished by its less inflated whorls and fewer constrictions. In England, B. *laevigatum* ranges from the *mammilatum* Zone to the *dentatus* Zone (lower Albian to lower middle Albian).

Beudanticeras glabrum (Whiteaves) figured from western Canada by Jeletzky (1964, pl.24, figs 5A-B, 6A-G) and from Alaska by Imlay (1960, pl.16, figs 14-21) has a similar suture and a narrow umbilicus with a gently sloping wall. However, B. *glabrum* is less inflated, has a more narrowly rounded venter and fewer constrictions than B. *sutherlandi*. In western Canada and Alaska B. *glabrum* occurs in lower and middle Albian strata.

In addition, the early Albian species *Beudanticeras affine* (Whiteaves) from western Canada (Jeletzky, 1964, pl.24, figs 4A-B) and Alaska (Imlay, 1961, p.57, pl.13, fig.24; pl.14, fig.2), and B. *multiconstrictum* Imlay (1960, p.105, pl.14, figs 1-2) (1961, p.56, pl.14, fig.1; pl.15, figs 1-12) from Alaska may be compared with B. *sutherlandi* (Etheridge Snr). B. *affine* differs from the Queensland species in its more narrowly arched venter, while B. *multiconstrictum* has more constrictions than B. *sutherlandi*. Imlay (1961) included B. *affine* and B. *multiconstrictum* in a new subgenus *Grantziceras*.

Beudanticeras sutherlandi (Etheridge Snr), occurs in the uppermost part of the Ranmoor Member and in the Toolebuc Limestone. The differences between this species and

B. flindersi (McCoy) from the Ranmoor Member, have already been discussed. B. ingente Whitehouse (1928a, p.202, pl.25, fig.1) from the Allaru Mudstone differs from B. sutherlandi in its larger size and its steep walled umbilicus.

As noted by Seitz (1932, p.414) the umbilicus dimension of 21% given for the holotype of Beudanticeras sutherlandi by Whitehouse (1928a, p.202) is incorrect. The umbilicus is actually 14% of the total diameter.

Occurrence:

Ranmoor Member: GAB1123; GAB1126; GAB1132.

Toolebuc Limestone: "Marathon" (Etheridge Snr, 1872); GAB803; GAB949.

Age: Late early - early late Albian.

Beudanticeras ingente Whitehouse, 1928

Pl.14, figs 3-4; pl.17, fig.3; text fig.13B,C

Synonymy:

1928a Beudanticeras ingente Whitehouse, p.202, pl.25, fig.1.

Type: Holotype: F5616 GSQ. Locality: "Beaconsfield", Allaru Mudstone, lower upper Albian.

Material: About 12 well preserved individuals and 30 incomplete specimens.

Specific diagnosis: Large Beudanticeras; umbilicus small with very steep sides; whorl section well inflated; flanks convergent ventrally; internal moulds with occasional periodic constrictions; ornament subdued, consisting of very fine ribs and growth striae; suture with narrow stemmed, deeply bifid saddles and broad irregularly trifid lobes.

Description: Generally large. Discoidal. Umbilicus small, with very steep sides. Whorl section elevated, well inflated, uniform throughout. Flanks gently convex, convergent ventrally. Venter narrowly arched; moulds with occasional periodic constrictions. Ornament subdued, consisting of numerous, very fine, closely spaced, slightly falciform ribs and fine growth striae. Sutures closely crowded, sometimes touching. Saddles narrow stemmed, very deeply bifid; lobes broad and irregularly trifid.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype F5616 GSQ	133mm	50%	31%	18%
CPC9265	210mm	53%	30%	16%

Remarks: Whitehouse (1928a, p.203) stated that the umbilicus of the holotype of Beudanticeras ingente (F5616 GSQ) comprised 23% of the total diameter. Seitz (1932, p.414) from an examination of Whitehouse's (1928a, pl.25, fig.1) illustration considered that this figure was too high. I have measured the holotype specimen and the umbilicus actually comprises 18% of the total diameter.

The European late Albian Beudanticeras beudanti (Brongniart), the type species of Beudanticeras, figured by

Spath (1923, pl.2, figs 4a-d; text fig.12) has a steep walled umbilicus like that of *B. ingente*, but is smaller and less inflated.

Beudanticeras ingente Whitehouse is a characteristic ammonite of the Allaru Mudstone. The huge species "*Beudanticeras*" *vinei* sp. nov., which also occurs in the Allaru Mudstone, is similarly inflated and has a steep walled umbilicus but has a much deeper ventral lobe. The distinctions between *B. ingente*, *B. flindersi* and *B. sutherlandi* have already been discussed.

Brewericeras mitchelli (Etheridge Snr, 1872) and *Boliteceras daintreei* (Etheridge Snr, 1872) from the uppermost horizons of the Ranmoor Member approach *Beudanticeras ingente* in whorl section, but both the Ranmoor species are strongly ribbed.

Occurrence:

Allaru Mudstone: "Beaconsfield" (Whitehouse, 1928a); GAB836; GAB882; GAB1085; GAB1394; GAB1416?; GAB1604; GAB1612.

Age: Early late Albian.

"*Beudanticeras*" *vinei** sp. nov.

Pl.2, fig.2; pl.20, fig.3; pl.21, fig.1;
pl.22, fig.10, text fig.13A

Types: Holotype: CPC9498. Paratypes CPC9499, CPC9500, CPC9501. Locality: GAB836, Allaru Mudstone, lower upper Albian.

*Named after Mr R.R. Vine of the Bureau of Mineral Resources, who collected several of the type specimens.

Material: Twenty large, incomplete individuals.

Specific diagnosis: Exceedingly large *Beudanticeras*; umbilicus narrow, steep walled; internal mould of body chamber with wide, deep, periodic constrictions bordered anteriorly by blunt ribs; ornament subdued, consisting of fine, closely spaced, falciform ribs; suture with asymmetrical, narrow stemmed saddles.

Description: Exceedingly large. Discoidal. Umbilicus small, steep walled. Whorl section elevated, well inflated. Juvenile stage unknown. Flanks gently convex, convergent ventrally. Venter narrowly rounded. Test of body chamber with strong periodic thickenings; periodic thickenings reproduced on internal moulds as wide, very deep constrictions. Blunt ribs developed along anterior edge of thickenings. Ornament as per specific diagnosis. Sutures crowded, touching; saddles asymmetrical, high and narrow stemmed; lobes broad, more or less symmetrical with a deep ventral lobe.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Holotype CPC9498	280mm+	160mm	-	40mm
Paratype CPC9499	440mm+	-	-	-
Paratype CPC9500	335mm+	165mm	-	40mm
Paratype CPC9501	250mm+	140mm	-	40mm

Remarks: "*Beudanticeras*" vinei sp. nov. is referred to the genus *Beudanticeras* with some reservation. The species attains an exceptionally large size for a *Beudanticeras* and approaches the dimensions of many species of <u>Puzosia</u> Bayle. However, typical <u>Puzosia</u> has a more depressed whorl section. The deep ventral lobe of the suture is also unusual for a <u>Beudanticeras</u>. The suture of <u>Desmoceras</u> Zittel is very similar, but that form also has a depressed whorl section.

Some specimens of <u>Cophinoceras</u> <u>ogilviei</u> Whitehouse (1928a, p.205, pl.26, figs 4a-b) from the late Albian Normanton Formation approach "<u>Beudanticeras</u>" <u>vinei</u> in size and ornament, but are more inflated. The suture of <u>C</u>. <u>ogilviei</u> is unknown, otherwise "<u>B</u>." <u>vinei</u> might be referred to Whitehouse's monotypic genus <u>Cophinoceras</u>. Casey (1961b, p.144) has pointed out that <u>Beudantiella</u> Breistroffer, a new name for <u>Cophinoceras</u> Whitehouse, is unnecessary, as Whitehouse's name is not preoccupied.

<u>Occurrence</u>:

<u>Toolebuc Limestone</u>: GAB945

<u>Allaru Mudstone</u>: GAB836

<u>Age</u>: Early late Albian.

Genus <u>Boliteceras</u> Whitehouse, 1928

<u>Type species</u> (by original designation): <u>Ammonites daintreei</u> Etheridge Snr, 1872, lower middle Albian, Great Artesian Basin.

<u>Generic diagnosis</u>: Discoidal, moderately involute shells. Whorl section somewhat depressed. Venter broadly rounded. Flanks slightly convergent. Test with periodic constrictions and low, closely spaced, sigmoid ribs that continue across the

venter. Suture with fairly broad bifid saddles and trifid lobes.

Range: Lower middle Albian.

Remarks: Wright (1957a) doubtfully included Boliteceras in the synonymy of Beudanticeras, but the distinctive ribbing of the group warrants its generic recognition. Whitehouse (1928a, p.203) regarded Boliteceras as an offshoot of the upper Aptian-middle Albian Uhligella Jacob. Such a derivation seems probable.

At present Boliteceras is an endemic genus known only from North Queensland and north-west New South Wales.

Boliteceras daintreei (Etheridge Snr), 1872

Pl.6, figs 1-4; pl.7, figs 5-6

Synonymy:

1872 Ammonites daintreei Etheridge Snr, p.346, pl.24, figs 1-2.

1892 Ammonites daintreei Etheridge Snr; Etheridge Jnr, p.495, pl.29, figs 1-3.

1901 Haploceras daintreei (Etheridge Snr); Etheridge Jnr, p.30, pl.1, fig.3; pl.2, fig.6.

1902b Haploceras daintreei (Etheridge Snr); Etheridge Jnr, p.49, pl.7, figs 2-4.

1902 Haploceras daintreei (Etheridge Snr); Etheridge Jnr and Dun, p.82. (pars.).

1926 Beudanticeras ? daintreei (Etheridge Snr); Whitehouse, p.221.

1928a <u>Boliteceras</u> <u>daintreei</u> (Etheridge Snr); Whitehouse, p.203, pl.26, fig.2.

1928a <u>Boliteceras</u> <u>perlatum</u> Whitehouse, p.204, pl.26, fig.3.

1932 <u>Beudanticeras</u> ? <u>daintreei</u> (Etheridge Snr); Seitz, p.412.

1932 <u>Boliteceras</u> <u>daintreei</u> (Etheridge Snr); Seitz, p.414.

1932 <u>Boliteceras</u> <u>perlatum</u> Whitehouse; Seitz, p.414.

<u>Types</u>: <u>Ammonites</u> <u>daintreei</u> Etheridge Snr. <u>Lectotype</u>:F3851 QM (lower, left hand specimen figured by Etheridge Snr, pl.24, fig.1). <u>Paralectotype</u>:F3852 QM (specimen figured by Etheridge Snr, 1872, pl.24, fig.2). <u>Locality</u>: "Hughenden", Ranmoor Member, upper lower or lower middle Albian. <u>Boliteceras</u> <u>perlatum</u> Whitehouse. <u>Holotype</u>:F1276 QM. <u>Locality</u>: "Hughenden", Ranmoor Member, upper lower or lower middle Albian.

<u>Material</u>: Three incomplete specimens.

<u>Specific diagnosis</u>: Medium-sized <u>Boliteceras</u> with somewhat depressed whorl section; flanks slightly convergent; venter broadly arched, umbilicus steep walled.

<u>Description</u>: Discoidal. Medium sized. Whorl section somewhat depressed. Flanks slightly convergent. Venter broadly arched. Early whorls more inflated than later whorls. Umbilicus steep walled. Internal moulds with periodic constrictions. Ribs numerous, low and broad, closely spaced, sigmoid; ribs continued across the venter without interruption. Suture with fairly broad bifid saddles and trifid lobes.

Dimensions:	Maximum diameter (D)	Diameter measurements taken (*D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Lectotype F3851 QM	124mm	-	48%	33%	24%
Paralectotype F3852 QM	-	65mm	48%	38%	23%
F1276 QM	130mm	-	45%	33%	23%

Remarks: Whitehouse's recognition of two species in the material figured by Etheridge Snr (1872, pl.24, figs 1-2) is not accepted here, for the lectotype of Boliteceras daintreei (F3851 QM) is damaged aperturally, and the convergence of the flanks mentioned by Whitehouse (1926) (1928a) is apparent, not real.

Seitz (1932, p.414), from an examination of the figures of Etheridge Snr and Whitehouse, noted that umbilicus dimensions of 35% and 30% of the total diameter quoted by Whitehouse (1928a, p.204) were incorrect. The correct dimensions are given above.

An incomplete specimen figured by Bonarelli (1921, pl.3, fig.5) from the Lake San Martin area of Argentina as Beudanticeras daintreei is not conspecific. Whitehouse (1926, p.221) suggested that the specimen be referred to Uhligella or Aioloceras.

Boliteceras daintreei is known only from the uppermost part of Ranmoor Member near Hughenden and from north west N.S.W. A fragmentary specimen from South Australia referred to the species by Etheridge Jnr (1902a, p.44, pl.7, fig.1) was separated by Whitehouse (1926, p.206) as Parahoplitoides ? sp.

Occurrence:

Ranmoor Member: "Hughenden" (Etheridge Snr, 1872); GAB1132.

N.S.W.: "Yandamah Ck. near Milparinka" (Etheridge Jnr, 1902b).

Age: Late early Albian.

Genus *Brewericeras* Casey, 1954

Type species (by original designation): *Ammonites breweri* Gabb, 1864, lower middle Albian, California.

Generic diagnosis: Shell discoidal; compressed. Flanks flat to slightly inflated. Venter narrowly and evenly rounded. Umbilicus small, with an abrupt to very sharp shoulder and a steeply sloping to vertical wall. Ornament consisting of falcate ribs of varying strength. Ribs commonly arise from bundled striae on the lower flank, or rarely arise singly at the umbilical margin, or spring from inconspicuous umbilical bullae. Ribs most prominent on the outer flank, where they project strongly forward. Ribs weak or indistinguishable on the venter. Constrictions scarce, although more coarsely costate forms tend to have a few falcate constrictions that are bordered on the venter by a posterior peripheral ridge.

Range: Upper lower - lower middle Albian.

Remarks: Casey (1954, p.112) proposed the genus *Brewericeras* for forms resembling *Beudanticeras* but with more slab sided whorls, a sharper umbilical rim and ribs that weaken on the venter. He included *Beudanticeras hulenense* Anderson (1938), *Ammonites breweri* Gabb and *A. haydeni* Gabb. Murphy and Rodda (1960, p.851) transferred the latter species to *Beudanticeras*.

Jones *et al.* (1965) studied large collections of *Brewericeras* and have revised Casey's concept of the genus. The generic diagnosis given above embodies their emendments. Jones *et al.* (1965) regard *Brewericeras* as a direct descendant of *Leconteites* Casey (1954), and include only two species in the genus, *Brewericeras breweri* (Gabb) and *B. hulenense* (Anderson).

Brewericeras has previously been reported only from northern California, British Columbia and southern Alaska (Jones *et al.*, 1965). The inclusion of *Ammonites beudanti* var. *mitchelli* Etheridge Snr (1872) in the genus markedly extends its geographic range. If the distribution of *Brewericeras* is isochronous, its Queensland occurrence indicates a late early Albian age for the topmost mudstones of the Ranmoor Member.

Brewericeras mitchelli (Etheridge Snr), 1872

Pl.3, figs 5-6; pl.15, figs 2-3; pl.19, fig.5; pl.23, fig.1; text fig.14

Synonymy:

1872 *Ammonites beudanti* Brongniart var. *mitchelli* Etheridge Snr, p.345, pl.23, figs 1-2.

1892 Ammonites flindersi McCoy; Etheridge Jnr, p.494 (pars.), pl.30, figs 1-3.

1902 Haploceras flindersi (McCoy); Etheridge Jnr and Dun, p.82 (pars.).

1923 Ammonites beudanti var. mitchelli Etheridge Snr; Spath, p.52.

1926 Beudanticeras flindersi (McCoy); Whitehouse, p.219 (pars.).

1928a Beudanticeras mitchelli (Etheridge Snr); Whitehouse, p.20, pl.25, fig.2.

1932 Beudanticeras mitchelli (Etheridge Snr); Seitz, p.414.

1936 Puzosia mitchelli (Etheridge Snr); Venzo, p.74.

1950 Puzosia mitchelli (Etheridge Snr); Collignon, p.70.

Types: Lectotype: (designated by Whitehouse, 1928a, p.201) F1274 QM (specimen figured by Etheridge Snr, pl.23, fig.1). Paralectotype: (now selected) F1275 QM (specimen figured by Etheridge Snr, pl.23, fig.2). Locality: "Hughenden", Ranmoor Member, upper lower or lower middle Albian.

Material: Six well preserved specimens.

Specific diagnosis: Medium sized Brewericeras with a bluntly rounded umbilical rim; flank costae widely spaced, well impressed on internal moulds.

Description: Medium sized. Discoidal; moderately involute. Umbilicus steep sided; umbilical rim bluntly rounded. Whorl section elevated, well inflated. Flanks almost flat, convergent ventrally. Venter broadly rounded. Flank ornamented with thick, well elevated, widely spaced costae, and fine, densely spaced ribs. Costae strongly impressed on internal moulds, straight near umbilical rim, slightly flexed adapically on mid-flank, fading and projecting adorally on venter. Ribs parallel costae, with tendency towards bundling near umbilical rim. Sutures closely crowded, sometimes touching; saddles broad-stemmed, bifid; lobes asymmetrically trifid.

Dimensions:	Maximum diameter (D)	Whorl height (WH)	Whorl thickness (WT)	Umbilicus (U)
Lectotype F1274 QM	130mm	50%	28%	20%
Paralectotype F1275 QM	80mm	51%	32%	22%
CPC9227	118mm	49%	26%	19%
CPC9262	175mm	48%	26%	-

Remarks: Spath (1923, p.52) considered that Ammonites beudanti Brongniart var. mitchelli Etheridge Snr (1872, p.345, pl.23, figs 1-2) was not congeneric with Beudanticeras. Whitehouse (1926, p.220) (1928a, p.201) had no such reservation, but he had failed to observe the strong flank ribbing developed on the lectotype (F1274 QM). Venzo (1937, p.74) and Collignon (1950, p.70) both referred the species to Puzosia, a genus that is generally more involute. Etheridge Snr's species is now included in Brewericeras, as it has a whorl section, ornament and suture closely comparable with that form.

TEXT FIG.14

SUTURES OF BREWERICERAS MITCHELLI (ETHERIDGE SNR)

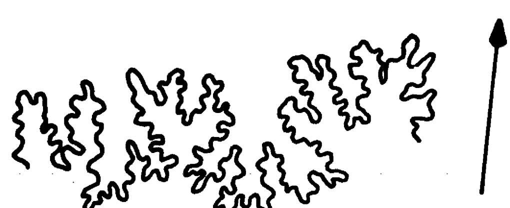
A CPC9262, suture at whorl height 58mm, X1; locality GAB1132, Ranmoor Member, Wallumbilla Formation, late early Albian.

B CPC9227, suture at whorl height 35mm, X1; same locality.

C F1274 QM, holotype, suture at whorl height 32mm, X1; locality "Hughenden", same formation.

A

B



C

The holotype and only known specimen of Brewericeras breweri (Gabb) from northern California, was figured by Jones et al. (1965, pl.8, figs 3-5). It differs from B. mitchelli (Etheridge Snr) in having costae that cross the venter without weakening.

Brewericeras hulenense (Anderson) figured by Jones et al. (1965, pl.8, figs 1-2, 4; pl.9, figs 1-9; pl.10, figs 1-15, pl.11, figs 1-3, 13-14) has quite variable ornament, but the flank costae when strongly developed are more closely spaced than those of B. mitchelli. Furthermore, the umbilical rim of the Queensland species is bluntly rounded, not sharp as in the North American Pacific Coast form.

As noted by Seitz (1932, p.414) the umbilicus dimension of 27% given for the lectotype of B. mitchelli by Whitehouse (1928a, p.201) is too high. The umbilicus of this specimen actually forms 20% of the total diameter.

Brewericeras mitchelli (Etheridge Snr) is readily distinguished from the other beudanticeratids of the Ranmoor Member (Beudanticeras flindersi (McCoy), Beudanticeras sutherlandi (Etheridge Snr) and Boliteceras daintreei (Etheridge Snr)) by its widely spaced, strong flank costae that fade across the venter.

Occurrence:

Ranmoor Member:"Hughenden"(Etheridge Snr, 1872); GAB1131, GAB1132, GAB1133.

Age: Late early Albian.

Subclass COLEOIDEA Bather, 1888

Order BELEMNITIDA Naef, 1921

Family Dimitobelidae Whitehouse, 1924

Remarks: Whitehouse (1924, p.410) erected this family for "cylindrical and clavate belemnites provided with lateral grooves on the anterior portion of the guard, but devoid of antero-ventral or apical grooves". Glaessner (1957, p.88) corrected Whitehouse's orientation of the lateral grooves of *Dimitobelus*, and showed that the family was characterized by the possession of two, deep ventro-lateral grooves.

The paired ventro-lateral grooves of dimitobelids constitute such a unique feature that the affinities of the family remain in dispute. Similarities of the double lateral lines and grooves of *Dimitobelus* to those of the Jurassic Belemnopseidae and Upper Cretaceous Belemnitellidae have led Glaessner (1957), Gustomesov (1962), and Stevens (1965) to suggest that the closest relationships of the Dimitobelidae are with these groups. However, Jeletzky (1966, p.148) considered that the absence from dimitobelids of the single ventral groove of belemnopseids and belemnitellids, argued against this relationship. He sought the ancestors of the Dimitobelidae among the Oxyteuthidae. Subsequently, Jeletzky (1966, p.162) saw in a work by Gustomesov (1966) evidence of a link between the Hastitidae and the Dimitobelidae. Two hastitid genera *Sachibelus* and *Lenobelus* from the Jurassic of

Siberia exhibited well developed paired ventro-lateral grooves apparently representing modifications of the more ventral elements of double lateral lines.

Day (1967b, p.6) accepted Roger's (1952) and Stevens's (1965) treatment of the Dimitobelidae as a subfamily of the Belemnitidae. However, in view of the uncertainty concerning the affinities of dimitobelids, family rank seems preferable for the group.

Currently only two dimitobelid genera are recognised. The Aptian- ? early Albian genus Peratobelus Whitehouse (1924) is confined to Australia; the Albian-Maestrichtian genus Dimitobelus Whitehouse (1924)(=Tetrabelus Whitehouse, 1924 and Cheirobelus Whitehouse, 1924) is found in Australia, New Zealand, New Guinea and possibly in Southern India.

Genus Dimitobelus Whitehouse, 1924

(=Tetrabelus Whitehouse, 1924; Cheirobelus Whitehouse, 1924)

Type species (by original designation): Belemnites canhami Tate, 1880 (=Belemnitella diptycha McCoy, 1867), Albian, Great Artesian Basin.

Generic diagnosis: Outline hastate, profile less hastate. Ventro-lateral grooves well developed, dorso-lateral grooves well developed or rudimentary. Grooves confined to the alveolar region and anterior portion of stem regions. Ventro-lateral grooves straight in the alveolar region, but posteriorly curving towards the mid-line of the flanks and shallowing markedly. Dorso-lateral grooves following a similar course, but usually curving more gradually towards mid-line of the flanks. Lateral lines present in apical and stem regions. Dorso-lateral lines derived from dorso-lateral grooves and ventro-lateral lines derived from ventro-lateral grooves, but the relationship of lateral lines to grooves is often obscure. Alveolar angle approx 20°. Position of protoconch usually near the shallowing and sharp curvature of the ventro-lateral groove. A pseudalveolus often developed; its degree of development varies between individuals and species.

Range: Albian - Maestrichtian.

Remarks: Glaessner (1957, p.88) observed that the deep grooves on guards of *Dimitobelus*, described by Whitehouse (1924, p.411) as dorso-lateral, were actually in a ventro-lateral position. Stevens (1965, p.60) confirmed Glaessner's observation. The diagnosis of *Dimitobelus* given above is essentially that of Stevens (1965, p.61).

Whitehouse (1924) separated the genera *Tetrabelus* and *Cheirobelus* from *Dimitobelus* on the supposed independence of the dorso-, and ventro-lateral grooves from the double lateral lines. However, Stevens (1965) argued cogently that this criterion is too dependent on preservation to be reliable. He placed *Tetrabelus* and *Cheirobelus* is synonymy with

Dimitobelus. Glaessner (1957) had previously regarded Cheirobelus as a synonym, and Tetrabelus as a subgenus of Dimitobelus.

Guards of Dimitobelus are usually more clavate than those of Peratobelus. In addition the double lateral lines and pseudalveolus of Dimitobelus are features not seen in Peratobelus.

Dimitobelus is known from the Albian of Australia, the Albian - Cenomanian of New Guinea, the Albian - Maestrichtian of New Zealand, and possibly from the Albian - Cenomanian of Southern India. Skwarko (1966, p.125) reported an occurrence of Dimitobelus in sediments of the Mullaman Beds which he assigned a Neocomian age. "Dimitobelus youngensis Skwarko" is here considered to be conspecific with the Aptian species Peratobelus australis (Phillips, 1870). In the Great Artesian Basin Dimitobelus is represented by D. diptychus (McCoy, 1867) (=D. canhami (Tate, 1880), D. liversidgei (Etheridge Jnr, 1892) (=D. stimulus Whitehouse, 1925), D. kleinii (Guerich, 1901) and possibly by the form designated Dimitobelus sp.

Dimitobelus diptychus (McCoy), 1867

Synonymy: Pl.33, figs 1-13; table 7

1867a Belemnitella diptycha McCoy, p.356.

1867b Belemnitella diptycha McCoy, p.42.

1867c <u>Belemnitella</u> <u>diptycha</u> McCoy, p.196.

1870 <u>Belemnites</u> <u>australis</u> Phillips, pl.16, figs 3-4 only.

1880 <u>Belemnites</u> <u>canhami</u> Tate, p.104, pl.4, figs 2a-c.

1889 <u>Belemnites</u> <u>canhami</u> Tate, p.230.

1892 <u>Belemnites</u> <u>canhami</u> Tate; Etheridge Jnr, p.490, pl.35, figs 3-5, 7-9, 12-14.

1902a <u>Belemnites</u> <u>canhami</u> Tate; Etheridge Jnr, p.49.

1902a <u>Belemnites</u> <u>eremos</u> Tate; Etheridge Jnr, p.51, pl.7, figs 18-21.

1902b <u>Belemnites</u> <u>canhami</u> Tate; Etheridge Jnr, p.45, pl.8, figs 8-9, ? fig.10; pl.9, fig.2.

1902 <u>Belemnites</u> <u>canhami</u> Tate; Etheridge Jnr and Dun, p.80.

1902 <u>Belemnites</u> <u>eremos</u> Tate; Etheridge Jnr and Dun, p.81 (<u>pars</u>.).

1924 <u>Dimitobelus</u> <u>canhami</u> (Tate); Whitehouse, p.411, text. figs 2,3,7.

1925 <u>Dimitobelus</u> <u>canhami</u> (Tate); Whitehouse, p.35, pl.2, figs 1-7, 9-11.

1957 <u>Dimitobelus</u> <u>diptychus</u> (McCoy); Glaessner, p.88.

1958 <u>Dimitobelus</u> <u>diptychus</u> (McCoy); Glaessner, p.221.

1959 <u>Dimitobelus</u> <u>diptychus</u> (McCoy); Dorman and Gill, p.91, pl.8, figs 1-2.

1965 <u>Dimitobelus</u> <u>diptychus</u> (McCoy); Stevens, p.62, 117, 121.

1965 <u>Dimitobelus</u> <u>diptychus</u> (McCoy); Day, p.419.

1966 <u>Dimitobelus</u> <u>diptychus</u> (McCoy); Ludbrook, p.191, pl.27, figs 1-11.

1966 _Dimitobelus canhami_ (Tate); Skwarko, p.124, pl.15, figs 13-14.

Types: _Belemnitella diptycha_ McCoy. _Holotype_: P2177 NMV. _Locality_: "Head of Flinders River", probably from Ranmoor Member, lower - lower middle Albian.

Belemnites canhami Tate. _Holotype_: Not located. _Locality_: "Wood Duck Creek", Maree Formation, Albian.

Material: About 200 specimens.

Specific diagnosis: _Dimitobelus_ with a robust, elongate guard; outline hastate; profile slightly hastate; apical region short; apex eccentric, closer to dorsal surface; apical angle approx 50°.

Description: Guard medium (length 50mm) to large (length 100mm) in size; robust; elongate. Outline hastate. Profile slightly hastate. Apex obtuse; eccentric; closer to dorsal surface. Apical region short. Apical angle 40-60°. Cross section subcircular in alveolar region, ellipical in stem and apical regions. Dorsal and ventral surfaces flattened; lateral surfaces gently convex. Ventro-lateral grooves deeply incised, straight in alveolar region, gently curved towards mid-flank on anterior part of stem region. Dorso-lateral grooves broad, usually faintly impressed, almost straight and converging on ventro-lateral groove near middle of stem region. Dorso- and ventro-lateral grooves weaken posteriorly and are continued across posterior half of stem region and apical region as lateral lines. Lateral lines weakly or strongly impressed,

	Actual length of guard preserved	Distance from apex to pro-toconch (l)	Minimum trans-verse diameter (dtm)	Maximum trans-verse diameter (dtM)	Minimum saggital diameter (dsm)	Maximum saggital diameter (dsM)	Distance between dtm and dtM (u)	Distance from apex to dtM (v)
P2177 NMV	92	-	13	18.5	13	14	55	28
F1370 GSQ	96	-	10.5	18	10	14.5	65	33
F1369 GSQ	76	-	12	16.5	10.5	12.5	44	32
ANU17908	74	-	4	7.5	-	-	42	22
CPC9246	79	-	13	18	10	14.5	45	23
CPC9304	87	-	7	11.5	-	-	45	25
CPC9305	60	44	-	-	4	6	-	-
CPC9306	67	55	9	14	-	-	42	23

Table 7: Dimensions (mm) of Dimitobelus diptychus (McCoy) measured after scheme in Avias (1953, pp.158-159) and Stevens (1965, pp.44-47).

species occur in association (Whitehouse, 1925) (Ludbrook, 1966).

Whitehouse (1925, p.35) thought that Dimitobelus diptychus (called D. canhami by Whitehouse) was allied to the New Zealand species D. superstes (Hector). Stevens (1965, pp.117-121, pl.21, figs 1-9; pl.22, figs 1-15; pl.23, figs 1-14; text figs 26h, 28, 29a-b) recently redescribed Hector's species and rejected Whitehouse's postulated relationship. Stevens considered that D. superstes was more cylindrical than D. diptychus, with more prominent ventro-lateral grooves and less well impressed lateral lines. A direct comparison of specimens of D. superstes, kindly furnished by Dr Stevens of the New Zealand Geological Survey, with those of D. diptychus showed that the two have similar apical features. However, the differences elaborated by Stevens (1965, p.121) would in most cases separate the two species. The New Zealand species ranges from the Motuan to the Mangaotanean (middle and upper Albian to Coniacian - Santonian) (Stevens, 1965, p.119). The range of the Australian species is lower Albian to ? lower upper Albian.

Occurrence:

Ranmoor Member: "Head of Flinders River" (McCoy, 1867a); "Flinders R. near Hughenden", "Cambridge Downs run, Flinders R., 6 miles from Richmond Downs Station"; "Thurloo (? Thurles), 200 miles N.W. of Bowen" (Etheridge Jnr, 1892); GAB1067; GAB1138; GAB1141.

Coreena Member: "Ward Creek" (Phillips, 1870); "Aramac Town well at 238ft"; "Barcaldine"; "Blackall road" (Etheridge Jnr, 1892); GAB1933; GAB2039; GAB2057; GAB2059; GAB2079; GAB2083; GAB2140; SB100; SB102; SB109.

Mullaman Beds: TT 60 (Skwarko, 1966).

Maree Formation: "Woodduck Ck near the Peake" (Tate, 1880); "Stuart's, formerly Cooper's Ck (Etheridge Jnr, 1902a) and several localities reported by Ludbrook (1966).

N.S.W.: Several localities reported by Etheridge Jnr (1902b).

Age: Early Albian.

Dimitobelus liversidgei (Etheridge Jnr), 1892

Pl.38, figs 14-22; table 8

Synonymy:

1892 *Belemnites ? liversidgei* Etheridge Jnr, p.491, pl.35, figs 17,19,20.

1892 *Belemnites* sp. ind. Etheridge Jnr, pl.35, figs 15,16,18.

1902 *Belemnites ? liversidgei* Etheridge Jnr; Etheridge Jnr & Dun, p.81.

1924 *Dimitobelus stimulus* Whitehouse, p.412.

1924 *Dimitobelus extremus* Whitehouse, p.412.

1925 *Dimitobelus stimulus* Whitehouse, p.35, pl.2, figs 8,12-17.

1925 *Dimitobelus stimulus* var. *extremis* Whitehouse, p.35, pl.2, figs 18-20.

1965 *Dimitobelus stimulus* Whitehouse; Stevens, p.62, 127.

1966 *Dimitobelus stimulus* Whitehouse; Ludbrook, p.192, pl.27, figs 12-21.

1966 Dimitobelus stimulus var. extremis Whitehouse; Ludbrook, p.192.

Types: Belemnites ? liversidgei Etheridge Jnr. Lectotype: (here designated) F5631 GSQ (specimen figured by Etheridge Jnr, 1892, pl.35, fig.20). Paralectotypes: F1372 GSQ, F5629 GSQ, F5630 GSQ (specimens figured by Etheridge Jnr, 1892, pl.35, fig.18, fig.17, fig.19 respectively). Locality: "Aramac", probably from Allaru Mudstone, lower upper Albian.

Dimitobelus stimulus Whitehouse. Holotype: S5594 GUGD (specimen figured by Whitehouse, 1925, pl.2, figs 14,17a-b). Paratypes: S5589-S5591 GUGD, S5593-S5594 GUGD. Locality: "Wood Duck Creek", Maree Formation, Albian.

Dimitobelus stimulus var. extremis Whitehouse. Lectotype: (here designated) S5595 GUGD (specimen figured by Whitehouse, 1925, pl.2, fig.18). Paralectotypes: S5596-S5597 GUGD. Locality: "Wood Duck Creek", Maree Formation, Albian.

Material: About 150 specimens.

Specific diagnosis: Dimitobelus with a slender, elongate guard; outline hastate; profile slightly hastate; apical region long; apex almost central; apical angle approx 35^{o}.

Description: Guard small (length 10mm) to large (length 100mm); elongate; slender; length about 6-9 times maximum diameter. Outline hastate. Profile slightly hastate. Apex acute; almost central; apical region long. Apical angle approx 35^{o}. Cross section elliptical throughout, dorsal and ventral surfaces flattened; lateral surfaces gently convex. Ventro-lateral grooves usually deeply incised, straight in alveolar region, gently curved towards mid-flank on anterior part of stem region. Dorso-lateral grooves broad, faintly impressed, straight on alveolar region, gently curved towards mid-flank on anterior part of stem region, becoming parallel to ventro-lateral groove. Dorso-lateral and ventro-lateral grooves weaken posteriorly and pass into lateral lines. Lateral lines weakly or strongly impressed, about 0.5mm apart, extending to apex. Alveolus short. Alveolar angle approx. 20°. Pseudalveolus and axial projection commonly developed. Axial line almost straight, subcentral, closer to ventral surface.

Remarks: *Dimitobelus stimulus* Whitehouse (1925, p.35, pl.2, figs 8,12-17) and *D. stimulus* var. *extremis* Whitehouse (1925, p.35, pl.2, figs 18-20) are slender guards with acute, almost central apices. They cannot be separated from those of *Belemnites* ? *liversidgei* Etheridge Jnr (1892, p.491, pl.35, figs 17,19,20). Whitehouse (1925) apparently overlooked Etheridge Jnr's nominate species, the types of which are refigured herein (pl.

The long, acutely pointed apical region of *Dimitobelus liversidgei* readily distinguishes the species from *D. diptychus* (McCoy). In Queensland, the two species appear to be stratigraphically separated. *Dimitobelus diptychus* occurs

	Actual length of guard preserved	Minimum trans-verse diameter (dtm)	Maximum trans-verse diameter (dtM)	Minimum saggital diameter (dsm)	Maximum saggital diameter (dsM)	Distance between dtm and dtM (u)	Distance from apex to dtM (v)
F5631 GSQ	30	2	3.5	-	-	15	10
F5629 GSQ	24	2	3	-	-	-	-
F5630 GSQ	25	3	4	-	-	-	-
F1372 GSQ	28	3	4	-	-	-	-
CPC9247	70	-	-	8	9	-	-
CPC9248	62	6	10	5	7.5	38	24

Table 8: Dimensions (mm) of Dimitobelus liversidgei (Etheridge Jnr) measured after scheme in Avias (1953, pp. 158-159) and Stevens (1965, pp.44-47).

in sediments below the Toolebuc Limestone; D. liversidgei is found in that unit and in formations above it. However, in South Australia the two species occur in association near Wood Duck Creek (Whitehouse, 1925) (Ludbrook, 1966).

Dimitobelus liversidgei (Etheridge Jnr) most closely resembles D. macgregori described from the Albian-Cenomanian of New Guinea by Glaessner (1945, p.160, pl.6, figs 12a-b) (1958, p.219, pl.26, figs 5a-b, 6; text fig.5) and from the upper Motuan to lower Ngaterian (Albian-Cenomanian) of New Zealand by Stevens (1965, p.121, pl.21, figs 10-12; pl.24, figs 1-3; text fig.29c).

Occurrence:

Toolebuc Limestone: GAB2035 ?

Allaru Mudstone: "Aramac"; "Blackall road" (Etheridge Jnr, 1892); GAB1041; GAB1935; GAB2028; GAB2034; GAB2048; GAB2050; GAB2054; GAB2063; GAB2067; GAB2069; GAB2070; GAB2104.

Mackunda Formation: GAB667; GAB678?; GAB811; GAB813; GAB815; GAB817; GAB822; GAB1107; GAB1108; GAB1223; GAB1930; GAB2103; Ju2.

Maree Formation: "Wood Duck Creek" (Whitehouse, 1925) and several localities reported Ludbrook (1966).

Age: Early late Albian.

Dimitobelus sp.

Synonymy:

cf. 1966 Dimitobelus ? selheimi (Tenison Woods); Ludbrook p.192, pl.27, figs 22-25.

Remarks: Several collections from the Mackunda Formation contain fragments of robust, slightly hastate guards with a deep alveolus and large phragmocone. Unfortunately the material is insufficient for formal description. Specimens described from Albian sediments in South Australia by Ludbrook (1966, pl.27, figs 22-25) as Dimitobelus ? selheimi (Tenison Woods) may be conspecific. The Albian form has no connection with the Aptian species Peratobelus selheimi (Tenison Woods) described in the succeeding section.

Occurrence:

Mackunda Formation: GAB674; GAB678; GAB813; GAB817; GAB850; GAB930; GAB1204; GAB1208; GAB1217; GAB1223; GAB1367; GAB1600; Ju2.

Age: Early late Albian.

Genus Peratobelus Whitehouse, 1924

Type species (by original designation): Belemnites oxys Tenison Woods, 1883, Aptian, Great Artesian Basin.

Generic diagnosis: Guards cylindro-conical. Outline non-hastate or slightly hastate. Profile non-hastate. Ventro-lateral grooves long, deeply incised, close to ventral surface;

straight on alveolar region; very gently curved towards ventral surface in middle of stem region; gently curved towards mid-flank and fading on posterior part of stem region. Dorso-lateral grooves rudimentary; faintly impressed, visible only on immature specimens; tapering and fading on stem region just before the termination of the ventro-lateral grooves. Lateral lines absent. Alveolus normal, sometimes very deep. Alveolar angle approx. 25°.

Range: Aptian- ? early Albian.

Remarks: The above diagnosis incorporates details of the dorso-lateral grooves recently observed on immature specimens of *Peratobelus oxys* (Tenison Woods) and *P. australis* (Phillips). The diagnoses of *Peratobelus* given by Whitehouse (1924, p.410) and Stevens (1965, p.61) are otherwise similar to the present one.

As noted by Day (1967b, p.7) the lateral grooves of immature specimens of *Peratobelus* closely resemble those illustrated by Gustomesov (1962, fig.3A-N) as typical of the subfamily Cylindroteuthinae. If lateral grooves are of prime taxonomic importance, as claimed by Gustomesov (1962), *Peratobelus* may be more closely related to cylindroteuthids than to *Dimitobelus*. However, *Peratobelus* lacks the single ventral groove of *Cylindroteuthis* and the ventro-lateral grooves of the former are much more deeply incised than those of the latter.

Dimitobelus Whitehouse (1924) has double lateral lines that are unknown in _Peratobelus_ and guards of the former are usually much more clavate than those of the latter.

Peratobelus is known only from Australia where it is essentially an Aptian genus. The oldest species is _Peratobelus australis_ (Pnillips, 1870) which first appears in the early Aptian Minmi Member of the Blythesdale Formation and ranges to the top of the late Aptian Doncaster Member of the Wallumbilla Formation. _Peratobelus oxys_ (Tenison Woods, 1883a) and _P. selheimi_ (Tenison Woods, 1883b) occur throughout the Doncaster Member. _Peratobelus robustus_ sp. nov. is found at the top of the Doncaster Member and at five localities in the lower part of the early Albian Coreena Member of the Wallumbilla Formation. In the Coreena Member, _Peratobelus robustus_ occurs in association with the Albian species _Dimitobelus diptychus_ (McCoy) in reworked "belemnite conglom- erates".

Peratobelus oxys (Tenison Woods), 1883

Pl.34, figs 1-6; pl.35, figs 4-8; table 9

Synonymy:

1883a _Belemnites australis_ (Phillips), Tenison Woods, p.236.

1883a _Belemnites oxys_ Tenison Woods, p.237, pl.13, figs 1-3.

1892 _Belemnites oxys_ Tenison Woods; Etheridge Jnr, p.488.

1902a _Belemnites oxys_ Tenison Woods; Etheridge Jnr, p.48.

1902b Belemnites oxys Tenison Woods; Etheridge Jnr, p.48, pl.6, figs 4-6; pl.7, figs 5-7; pl.8, figs 4-6, ? 7.

1902 Belemnites oxys Tenison Woods; Etheridge Jnr and Dun, p.81.

1924 Peratobelus oxys (Tenison Woods); Whitehouse, p.410, text figs 1a-b.

1928 Peratobelus oxys (Tenison Woods); Whitehouse, p.277.

1961 Peratobelus sp. Woods, p.6.

1964 Peratobelus oxys (Tenison Woods); Day, p.18, table 3.

1964 Peratobelus sp. aff. P. oxys (Tenison Woods); Day, table 3.

1965 Peratobelus oxys (Tenison Woods); Day, p.418-419.

1965 Peratobelus oxys (Tenison Woods); Stevens, p.61.

1966 Peratobelus oxys (Tenison Woods); Ludbrook, p.192, pl.27, fig.3.

1966 Peratobelus (?) bauhinianus Skwarko, p.124, pl.15, figs 7-11.

1967b Peratobelus sp. Day, p.7.

Types: Belemnites oxys Tenison Woods. Holotype: Macleay Museum, University of Sydney. Locality: "Well sinking on Mt Stuart Run, north-west N.S.W. at a depth of 90ft," probably from equivalents of the Doncaster Member, upper Aptian. Peratobelus (?) bauhinianus Skwarko. Holotype: CPC4795. Locality: TT20, Mullaman Beds, Aptian. Paratype: CPC4796. Locality: TT21, Mullaman Beds, Aptian.

Material: About 50 guards, many of which are incomplete.

Specific diagnosis: Slender to moderately robust *Peratobelus* with an acute, eccentric apex.

Description: Guard small (length 20mm) to large (length 120mm); slender to moderately robust; elongate. Outline cylindro-conical or slightly hastate. Profile cylindro-conical. Apex acute; eccentric, closer to dorsal surface. Apical region long. Apical angle 20-30°. Cross section variable; sub-circular throughout, or elliptical in stem region. Dorsal and ventral surfaces sometimes markedly flattened. Lateral surfaces gently convex. Ventro-lateral grooves long, very deeply incised; straight in alveolar region; very gently curved towards ventral surface in middle of stem region; gently curved towards mid-flank and fading on posterior part of stem region. Dorso-lateral grooves broad, straight; faintly impressed, visible only on immature specimens; tapering and fading on stem region just before the termination of the ventro-lateral grooves. Shallow medio-lateral lines developed on the alveolar, and part of the stem region in some specimens. No lateral lines. Alveolus shallow; guard markedly thicker on ventral side of alveolus. Alveolar angle approx. 25°. Pseudalveolus not developed. Phragmocone small. Apical line curved, closer to ventral surface.

Remarks: The holotype of this species was refigured by Etheridge Jnr (1902b, pl.6, figs 4-6) who reported that it

	Actual length of guard preserved	Distance from apex to protoconch (l)	Minimum transverse diameter (dtm)	Maximum transverse diameter (dtM)	Minimum saggital diameter (dsm)	Maximum saggital diameter (dsM)	Distance between dtm and dtM (u)	Distance from apex to dtM (v)
F8431 GSQ	48	-	8	9	8	8.5	20	24
CPC9248	55	42	-	-	6	7	-	-
CPC9269	55	41	-	-	7	8	-	-
CPC9251	85	-	19	20	16	18	38	40
CPC9252	115	-	19	21	18	19.5	40	52
CPC9896	115	-	17.5	18	15	17	35	46

Table 9: Dimensions (mm) of Peratobelus oxys (Tenison Woods) measured after scheme in Avias (1953, pp.158-159) and Stevens (1965, pp.44-47).

was housed in the Macleay Museum. However, the writer was unable to locate the specimen during a brief visit to the University of Sydney.

Shallow dorso-lateral grooves are evident on some guards of Peratobelus oxys. These have not been observed with certainty on mature guards. Some mature guards are flattened dorso-laterally in the alveolar region. The flattened areas taper posteriorly and may represent vestiges of dorso-lateral grooves. Ventro-lateral grooves of mature specimens also tend to be straighter than those of immature guards. Typical juvenile guards of Peratobelus oxys were described from the Mullaman Beds by Skwarko (1966, p.124, pl.15, figs 7-11) as Peratobelus ? bauhinianus.

Peratobelus oxys (Tenison Woods, 1883a) is most closely related to P. robustus sp. nov. described below. Both have an eccentric apex and a curved apical line set closer to the ventral surface. The former is distinguished by its long apical region, acute apex and shallow alveolus.

Both Peratobelus australis (Phillips, 1870) and P. selheimi (Tenison Woods, 1883b) described below have a central apex and an almost straight subcentral axial line quite unlike those of P. oxys. In the Queensland portions of the Eromanga and Surat Basins occurrences of Peratobelus oxys are confined to Doncaster and Jones Valley Members of the Wallumbilla Formation.

Occurrence:

Doncaster Member: RD5; RD83; RD87; RD90; RD91; RD92; RD111; RD116; GAB870?; GAB884; GAB1036; GAB1137; GAB1235; GAB1405; GAB2094; GAB2116?; GAB2117?; SB105; SB114; BMR Richmond 2 (100'9"-100'10½").

Jones Valley Member: GAB699; GAB1139; GAB1140.

Blackdown Formation: Woods (1961).

Mullaman Beds: Skwarko (1966).

Maree Formation: Ludbrook (1966).

N.S.W. Etheridge Jnr (1902b).

Age: Late Aptian.

Peratobelus robustus* sp. nov.

Pl.34, figs 8-12; pl.35, fig.12; table 10

*An allusion to the stoutness of the guard.

Synonymy:

1961 ? Peratobelus selheimi (Tenison Woods) - guards only; Woods, p.6.

1967a Peratobelus selheimi ? (Tenison Woods); Day, p.10.

Types: Holotype: CPC9310, a large guard in profile section.

Paratypes: CPC9308, large guard in outline section; CPC9309, large guard on profile section; CPC9843, CPC9844 large guards. Locality: Holotype and Paratypes CPC9308 - CPC9309, GAB1933; Paratypes CPC9843 and CPC9844, GAB2059. All specimens from Coreena Member, lower Albian.

Material: About 50 guards mostly tightly bonded in a matrix of calcareous, silty sandstone.

Specific diagnosis: Large, robust *Peratobelus* with a moderately obtuse, eccentric apex; apical and stem regions short; alveolus very deep.

Description: Guard large (length 60-120mm); robust; elongate. Outline cylindro-conical. Profile similar to outline. Apex moderately obtuse; eccentric, closer to dorsal surface. Apical angle approx 40°. Apical and stem regions short. Alveolar region long. Cross section sub-circular throughout. Dorsal and ventral surfaces sometimes slightly flattened in stem region. Lateral surfaces convex. Ventro-lateral grooves long; very deeply incised; straight in the alveolar region; very gently curved towards the ventral surface in middle of stem region; gently curved towards mid-flank and fading on posterior part of stem region. Dorso-lateral grooves unknown. No lateral lines. Alveolus very deep; guard markedly thicker on ventral side of alveolus. Alveolar angle approx. 25°. Pseudalveolus not developed. Phragmocone large. Apical line curved, closer to ventral surface.

Remarks: As discussed above *Peratobelus robustus* sp. nov. is closely related to *P. oxys* (Tenison Woods). The former is distinguished by its short apical region, moderately obtuse apex, and deep alveolus accommodating a large phragmocone.

	Actual length of guard preserved	Distance from apex to proto-conch (1)	Minimum trans-verse diameter (dtm)	Maximum trans-verse diameter (dtM)	Minimum saggital diameter (dsm)	Maximum saggital diameter (dsM)	Distance between dtm and dtM (u)	Distance from apex to dtM (v)
CPC9309	65	-	-	-	21	23	-	-
CPC9308	85	c.50	18	20	-	-	c.40	c.25
CPC9844	90	58	19	20	-	-	c.50	25
CPC9843	100	-	18	20	-	-	c.60	35
CPC9310	105	c.60	-	-	25	26	-	-

Table 10: Dimensions (mm) of <u>Peratobelus robustus</u> sp. nov. measured after scheme in Avias (1953, pp.158-159) and Stevens (1965, pp.44-47).

Peratobelus selheimi (Tenison Woods 1883b) has a large phragmocone like that of P. robustus sp. nov. However, the guard of the former is slender and short and the phragmocone extends anteriorly beyond the alveolus.

Peratobelus robustus sp. nov. occurs at the top of Doncaster Member in the Tambo area and in the lower part of the Coreena Member in the Tambo, Augathella and Mitchell areas. Occurrences in the Coreena Member may be remanie ones as the species is associated there with the early Albian belemnite Dimitobelus diptychus in "belemnite conglomerates". Peratobelus robustus sp. nov. also occurs in the Blackdown Formation where it was identified by Woods (1961, p.6) as "Peratobelus selheimi (Tenison Woods) - guards only".

Occurrence:

Doncaster Member: GAB2092; GAB2101.

Coreena Member: GAB1933; GAB2039; GAB2057; GAB2059; SB100.

Blackdown Formation: W14 (Woods, 1961).

Age: Late Aptian - early Albian.

Peratobelus selheimi (Tenison Woods), 1883

Pl.34, fig.7; pl.35, figs 9-11

Synonymy:

1883b Belemnites selheimi Tenison Woods, p.150, pl.7, fig.1.

1889 Belemnites selheimi Tenison Woods; Tate, p.230.

1892 Belemnites sellheimi Tenison Woods; Etheridge Jnr, p.489, pl.35, figs 10-11.

1902a *Belemnites sellheimi* Tenison Woods; Etheridge Jnr, p.50, pl.7, figs 16-17.

1902 *Belemnites selheimi* Tenison Woods; Etheridge Jnr and Dun, p.81.

1961 *Peratobelus selheimi* Tenison Woods; Woods, p.3,6.

1964 *Peratobelus* ? *selheimi* Tenison Woods; Day, table 3.

1964 *Peratobelus selheimi* Tenison Woods; Day, p.18.

Type: The repository of the holotype of this species is not known. Locality: "Palmer River", probably from Blackdown Formation, upper Aptian.

Material: Five isolated large phragmocones and two specimens with guard and phragmocone preserved.

Specific diagnosis: Small, slender *Peratobelus* with an enormous phragmocone.

Description: Guard small (Maximum observed length 40mm); slender. Apical and stem regions short. Outline and profile cylindro-conical. Apex moderately obtuse, central. Apical angle approx. 50°. Cross section elliptical. Dorsal and ventral surfaces flattened. Lateral surfaces gently convex. Ventro-lateral grooves deeply incised, not clearly visible in this material. Dorso-lateral grooves unknown. No lateral lines. Alveolar region long. Alveolus deep. Alveolar angle approx. 25°. Pseudalveolus not developed. Phragmocone very large, (up to 90mm in length and 45mm in diameter), extending anteriorly beyond the guard. Apical line almost straight, central.

Dimensions: (mm)

	Actual length of guard preserved	Total length of guard (L)	Distance from apex to protoconch (1)	Minimum saggital diameter (dsm)	Maximum saggital diameter (dsM)
CPC9267	42	42	18	6	9

Remarks: Descriptions of "Belemnites" selheimi given by Tenison Woods (1883b) and Etheridge Jnr (1892) (1902a) are based solely on phragmocones of enormous size. Two specimens (CPC9267, CPC9268) in the present collections have large phragmocones associated with quite short, slender guards. The phragmocone extends anteriorly well beyond the alveolar region. They are closely comparable with a guard and phragmocone (F10502 GSQ) of Peratobelus selheimi reported by Woods (1961, p.6) from W14 in the Blackdown Formation of the Wrotham Park area. The holotype of "Belemnites" selheimi, from the "Palmer River", an area adjacent to Wrotham Park, was probably found in equivalents of the Blackdown Formation. The writer has been unable to locate the holotype specimen.

Guards of Peratobelus selheimi (Tenison Woods, 1883b) without phragmocones may be confused with those of P. australis (Phillips, 1870), as both have a moderately obtuse, central apex and an almost straight subcentral axial line. However, the stem region of P. selheimi is proportionately shorter than that of P. australis. The discrimination of Peratobelus selheimi (Tenison Woods, 1883b) from P. robustus sp. nov. has already been discussed.

Specimens described from South Australia by Ludbrook (1966, p.192, pl.27, figs 22-25) as Dimitobelus ? selheimi (Tenison Woods) are not conspecific. They are probably representatives of an undescribed species of Dimitobelus.

Occurrence:

Doncaster Member: "Flinders River near Hughenden" (Etheridge Jnr, 1892); RD92; GAB1145; GAB2089; SB117; SB129.

Blackdown Formation: "Palmer River" (Tenison Woods, 1883b); W14; W23 (Woods, 1961).

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a).

Peratobelus australis (Phillips), 1870

Pl.35, figs 1-3; table 11

Synonymy:

1870 Belemnites australis Phillips, p.258, pl.16, figs 1, 2,5 only.

1870 Belemnites paxillosus ? Schlotheim; Moore, p.259, pl.16, figs 6, 6a-b.

1889 Belemnites eremos Tate, p.229.

1892 Belemnites australis Phillips, Etheridge Jnr, p.487, pl.35, figs 1-2.

1892 Belemnites eremos Tate; Etheridge Jnr, p.488, pl.35, fig.6.

1902 Belemnites australis Phillips; Etheridge Jnr and Dun, p.80.

1924 Peratobelus australis (Phillips); Whitehouse, p.410, fig.6.

1928 Peratobelus australis (Phillips); Whitehouse, p.277,278.

1960 Peratobelus australis (Phillips); Day, p.311.

1964 Peratobelus australis (Phillips); Day, table 3.

1964 Peratobelus sp. Day, table 3.

1965 Peratobelus australis (Phillips); Stevens, p.61.

1966 Dimitobelus (?) youngensis Skwarko, p.125, pl.15, figs 1-6,12.

1967b Peratobelus australis (Phillips); Day, pl.1, figs 22-23, text fig.1a-d.

Types: Belemnites australis Phillips. Lectotype: Specimen figured by Phillips (1870, pl.16, figs 1-2). Locality: "Queensland".

Dimitobelus ? youngensis Skwarko. Holotype: CPC4790. Paratype: CPC4794. Locality: "TT55", Mullaman Beds, Aptian.

Material: Two reasonably complete guards and about 20 less complete specimens.

Specific diagnosis: Moderately robust Peratobelus with an obtuse, central apex.

Description: Guard small to medium sized (length 30-60mm); elongate; moderately robust. Outline and profile slightly hastate. Apex obtuse, central. Apical region short. Apical angle approx. 50°. Stem region long. Cross section elliptical. Dorsal and ventral surfaces gently convex. Lateral surfaces flattened in alveolar region and on anterior part of stem region; gently convex on posterior part of stem region. Ventro-lateral grooves long, very deeply incised; straight in alveolar region; very gently curved towards the ventral surface on middle part of stem region; bent sharply towards mid-flank on posterior part of stem region; fading at commencement of apical region. Dorso-lateral grooves broad, straight; faintly impressed, visible only on immature specimens; tapering and fading on stem region just before termination of ventro-lateral grooves. Some specimens with shallow, medio-lateral grooves developed on alveolar and anterior part of stem region. No lateral lines. Alveolar region comparatively short. Alveolus shallow; guard thicker on ventral side of alveolus. Alveolar angle approx. 25°. Phragmocone small. Apical line almost straight, subcentral.

Remarks: The lectotype specimen of Belemnites australis Phillips (1870) selected by Day (1967b, p.6) was apparently lost in the "Garden Palace" fire in Sydney in 1882. However, selection of a neotype is deferred as the present collections contain no suitable specimens.

Guards described from the Minmi Member by Day (1967b, p.6, pl.1, figs 22-23, text fig.1a-d) as ? Peratobelus australis Phillips, are now regarded as immature individuals

	Actual length of guard preserved	Distance from apex to proto-conch (1)	Minimum trans-verse diameter (dtm)	Maximum trans-verse diameter (dtM)	Minimum saggital diameter (dsm)	Maximum saggital diameter (dsM)	Distance between dtm and dtM (u)	Distance from apex to dtM (v)
F35511 UQ	37	-	8.5	9.5	9	9.5	20	13
CPC9848	40	28	-	-	8	9.5	-	-
F35606 UQ	65	-	8.2	9.25	9	10	30	21

Table 11: Dimensions (mm) of Peratobelus australis (Phillips) measured after scheme in Avias (1953, pp.158-159) and Stevens (1965, pp.44-47).

of Phillips's species. The dorso-lateral and ventro-lateral grooves of these guards compare closely with those of immature individuals of *Peratobelus oxys* (Tenison Woods). Lateral grooves of the same pattern are evident on small guards described from the Mullaman Beds by Skwarko (1966, p.125, pl.15, figs 1-6,12) as *Dimitobelus* ? *youngensis*. Skwarko's species is here considered a synonym of *Peratobelus australis* (Phillips).

As noted above, guards of *Peratobelus selheimi* (Tenison Woods, 1883b) resemble those of *P. australis* (Phillips), both species possessing a moderately obtuse, central apex, and an almost straight subcentral axial line. The two species are distinguished primarily by their phragmocones, which are of normal size in *P. australis*, but relatively enormous in *P. selheimi*. In addition, the stem region of *P. australis* is proportionately longer than that of *P. selheimi*.

The eccentric apex and curved axial line of *Peratobelus oxys* (Tenison Woods, 1883a) and *P. robustus* sp. nov. readily distinguish those species from *P. australis*.

Occurrence:

Minmi Member: RD6?; RD95; RD99; RD207?; L143 GSQ; SB118.

Doncaster Member: ? "Queensland" (Phillips, 1870); "Wollumbilla" (Moore, 1870); RD46; RD122; GAB2094; GAB2101; GAB2117?

Maryborough Formation: Whitehouse (1928, p.278).

Mullaman Beds: TT45?; TT55 (Skwarko, 1966).

Class BIVALVIA Linnaeus, 1758

Subclass PALAEOTAXODONTA Korobkov, 1954

Order NUCULOIDEA Morton, 1963

Superfamily NUCULACEA Gray, 1824

Family Nuculidae Gray, 1824

Remarks: This family includes closed, equivalve, inequilateral, trigonal or ovate shells, with nacreous interiors, the posterior end shorter than the anterior, opisthogyral beaks, taxodont dentition, an internal or "separated" ligament housed in a chondrophore, and a simple pallial line. The group has been rigorously discussed from the standpoint of shell morphology by Schenck (1934), and his proposals have influenced much subsequent work. More recently Van de Poel (1955) has classified the group on shell structure alone. The relative stability of nuculid characters renders subdivision of the family difficult. Vokes (1967) refers 25 validly proposed genera and/or subgenera to the Nuculidae. However, there is little agreement on the ranking of these taxa.

According to Cox (1959) the Nuculidae first appeared in the Devonian and have survived to the present with little modification. McAlester (1964) records older Palaeozoic forms neither typically nuculid nor nuculanid, but notes that post-Palaeozoic representatives of the Nuculidae and Nuculanidae are clearly separable.

Genus Leionucula Quenstedt, 1930

(= Ennucula Iredale, 1931)

Type species (by original designation): Nucula albensis d'Orbigny, 1844, Albian, France.

Generic diagnosis: Quadrangular- ovate nuculids. Weakly inflated. Dorsal and ventral margins convex; anterior extremity bluntly pointed; posterior obliquely truncate. Escutcheon depressed. Chondrophore prominent, directed anteriorly. Teeth numerous, the larger teeth chevron shaped; anterior tooth row with about twice as many teeth as the posterior row. Inner ventral margin smooth. Exterior with concentric growth stages but without definite ribs.

Range: Cretaceous - Recent.

Remarks: There has been little agreement on the rank to be assigned to this group of species. Leionucula was proposed by Quenstedt (1930, p.112), as a "section" of Nucula (Nucula) to include Cretaceous and Recent forms with smooth inner ventral margins. Schenck (1934) placed Leionucula in his "systematic rank unsettled" category. He thought it might prove to be closely related to the Recent Australian genus Ennucula Iredale (1931), when the hinge of the type species of Leionucula became known. Thiele (1934, p.786) regarded Leionucula as a subgenus of Nucula and relegated Ennucula to its synonymy. Cox (1940, p.12) and Casey (1961c, p.605) also considered Leionucula to be a subgenus of Nucula, while Van de Poel (1955) classified Leionucula as a subgenus of Nuculoma Cossmann. Ichikawa and Maeda (1958b) elevated Leionucula to generic rank, and their view is adopted here.

The slight differences between Nucula albensis d'Orbigny, the type species of Leionucula, and Nucula obliqua Lamarck, the type of Ennucula, do not appear to warrant generic separation of the two. The writer follows Thiele (1934) in regarding the genera as synonyms.

Palaeonucula Quenstedt (1930), type species Nucula hammeri de France, is closely related to Leionucula, but is more inflated and has almost vertical posterior truncation. According to Ichikawa and Maeda (1958b), Leionucula was probably derived from the Jurassic Palaeonucula. This view seems feasible as Cox (1940) reported species somewhat intermediate between Palaeonucula and Leionucula from the Upper Jurassic of India, and Leionucula cooperi (Moore) described below is a further intermediate.

Leionucula is probably a cosmopolitan genus, but many of its species have been referred to Nucula by conservative taxonomists.

Leionucula quadrata (Etheridge Snr), 1872

Pl.36, figs 5-9

Synonymy:

1872 Nucula quadrata Etheridge Snr, p.341, pl.19, fig.5; pl.20, fig.3.

1872 Nucula gigantea Etheridge Snr, p.341, pl.20, fig.4, non Roemer, 1836.

1892 Nucula quadrata Etheridge Snr; Etheridge Jnr, p.565, pl.26, figs 8,9.

1892 Nucula gigantea Etheridge Snr; Etheridge Jnr, p.566, pl.26, figs 6,7.

1902a Nucula quadrata Etheridge Snr; Etheridge Jnr, p.23, pl.13, figs 13,14.

1966 Nucula etheridgei Ludbrook, p.147, pl.14, figs 6-8, nom. nov. for Nucula gigantea Etheridge Snr.

1966 Nucula quadrata Etheridge Snr; Ludbrook, p.147, pl.14, figs 9-12.

1966a Leionucula quadrata (Etheridge Snr); Fleming, p.6, pl.2, figs 1-5; pl.3, figs 1-5.

1967 Nucula sp. cf. N. etheridgei Ludbrook; Skwarko, p.14, pl.3, figs 2-3.

Types: Nucula quadrata Etheridge Snr. Lectotype:F1245 QM.

Nucula gigantea Etheridge Snr. Lectotype: F1244 QM. Locality: Both from "Maryborough", Maryborough Formation, Aptian.

Material: Twenty internal and external moulds mainly with valves separated.

Specific diagnosis: Comparatively large, ovate-quadrate Leionucula, with broad, prominent umbones situated two-thirds of shell length from the anterior end; dorsal margins forming an angle of about 130° at the beak; accessory (pedal) musculature consisting of fused central and median scars; 2 punctiform scars in the left valve and 3 in the right.

Description: Medium to comparatively large (length 10-40mm). Relatively thick shelled. Ovate-quadrate. Equivalve. Inequilateral. Moderately inflated. Umbones broad and prominent; beaks opisthogyral, situated two-thirds of shell length from anterior end. Escutcheon depressed. Dorsal margins arched, forming an angle of about 130° at the beak. Ventral margins evenly rounded, meeting the dorsal at mid-height. Chondrophore prominent, oblique, directed anteriorly. Anterior tooth row with up to 20 teeth which rapidly diminish in size above the chondrophore, large teeth chevron-shaped. Posterior tooth row with half as many teeth. Chondrophore tooth well developed. Adductor muscle scars erectly ovate, equal in size, deeply impressed; posterior adductor scar strongly buttressed. Median accessory muscle scar deeply impressed, apparently fused to the central accessory muscle scar; 2 punctiform scars in the left valve, 3 in the right. Inner ventral margins smooth. Pallial line simple. Exterior ornament consisting of fine growth lines and widely spaced, concentric depressions marking growth halt.

		Length	Anterior length	Height	Inflation
Dimensions:(mm)					
Lectotype	F1245 QM	38	25	28	19
	CPC9193	28+	17	24	6 (1 valve)
	CPC9194	30	20	21+	6 (")
	CPC9196	20	13	15	11
	CPC9195	15	10	12	5 (1 valve)

Remarks: Specimens from the Great Artesian Basin closely resemble the types from Maryborough recently redescribed by Fleming (1966a). Fleming's work confirms the suggestion of Etheridge Jnr (1902a,p.24) that Nucula quadrata and N. gigantea are synonyms. The former has page precedence. Nucula etheridgei, a substitute name proposed by Ludbrook (1966, p.147) for the preoccupied Nucula gigantea

Etheridge Snr, is therefore not required.

Ludbrook incorrectly oriented the South Australian specimens she described and, in consequence, the posterior is stated to be longer than the anterior.

A feature of Leionucula quadrata is its reduced number of accessory muscle scars. The terminology for these scars suggested by Odhner (in Schenck, 1934) is preferred here to that of Heath (1937), as it avoids the need to interpret the function of the scars in order to name them.

In general outline Leionucula quadrata (Etheridge Snr) resembles L. obtusa (Sowerby) figured by Gardner (1884, pl.4, figs 1-2) and Woods (1899, pl.4, figs 2-4) from the Cenomanian of England, and to a lesser extent the English Albian and Cenomanian species L. ovata (Mantell) figured by Gardner (1884, pl.3, figs 1-3; pl.4, figs 28-30) and Woods (1899, pl.3, figs 16-21; pl.4, fig.1). Leionucula azenotanensis Ichikawa and Maeda (1958b, pl.3, figs 5-8) from the Campanian-Maestrichtian of Japan is also similar.

Leionucula quadrata is not as elliptical in shape as L. doncasterensis sp. nov., is more inflated and has fewer accessory muscle scars.

Occurrence:

Maryborough Formation: "Maryborough" (Etheridge Snr, 1872).

Doncaster Member: SB129; GAB2101; GAB2162.

Allaru Mudstone: "Aramac" (Etheridge Jnr, 1892); GAB1041; GAB1085; GAB1228 ?; GAB2028; GAB2049; GAB2104; BMR Longreach 2

(131'-134'3").

Mackunda Formation: GAB667; GAB671; GAB822; GAB1301; GAB1368; GAB2103?

Maree Formation: "Lake Eyre Basin"; "Primrose Springs E. of the Peake, Central Australia" (Etheridge Jnr, 1902a) and several localities reported by Ludbrook (1966).

Age: Late Aptian - Early late Albian.

Leionucula aff. quadrata (Etheridge Snr), 1872

Pl.36, figs 10-11

Material: An internal and external mould of a left valve.

Description: Small (length approx. 15mm). Ovate. Inequilateral. Weakly inflated. Beaks small, opisthogyral, situated two-thirds of shell length from anterior end. Dorsal margins gently arched, forming an angle of about 140° at the beak. Ventral margins evenly rounded, meeting the dorsal margin at mid-height. Chondrophore prominent, oblique, directed anteriorly. Posterior tooth row with about 5 small teeth. Anterior tooth row with about 15 small teeth which diminish rapidly in size above the chondrophore. Posterior adductor muscle scar moderately impressed; other muscle scars obscure. Inner ventral margins smooth. Exterior ornamented with fine concentric growth lines.

Dimensions:(mm)	Length	Anterior length	Height	Inflation
CPC9197	16	11.5	11	3 (1 valve)
CPC9364	15	10	10	3 (")

Remarks: This form is probably a distinct species, but in view of the limited material available, it is not formally named. Leionucula quadrata (Etheridge Snr) is clearly related, but its posterior dorsal margin has a steeper slope than that of the present specimens.

Occurrence:

Nullawurt Member: SB221; SB230.

Age: Neocomian.

Leionucula doncasterensis* sp. nov.

Pl.36, figs 12-15

*Named after the Doncaster Member of the Wallumbilla Formation.

Types: Holotype: CPC9190, internal and external moulds of a left valve. Locality: GAB1145.

Paratypes: CPC9200, internal and external moulds of closed valve. CPC9199, CPC 9201, internal moulds of closed valves.

Locality: Paratype CPC9199, GAB1137; Paratype CPC9200, GAB2159; Paratype CPC9201 BMR Richmond 2 (153'4"-153'4½"). All specimens from the Doncaster Member, Upper Aptian.

Material: As above.

Specific diagnosis: Transversely elliptical Leionucula, with small inconspicious umbones situated three-quarters of shell length from the anterior end; dorsal margins forming an angle of 160° at the beak; accessory (pedal) musculature consisting of a central scar, an elongate median scar with 4 small scars behind, and 6-8 punctiform scars.

Description: Medium sized (length 22-38mm). Transversely elliptical. Equivalve. Markedly inequilateral. Moderately inflated. Umbones small, inconspicuous; beaks opisthogyral, situated almost three-quarters of shell length from the anterior end. Dorsal margins very weakly arched, forming an angle of about 160° at the beak. Ventral margins gently convex, meeting the dorsal slightly above mid-height. Chondrophore not visible in this material. Tooth rows incompletely exposed. Anterior row with at least 12 taxodont teeth. Adductor scars very dorsally situated, erectly ovate, equal in size, deeply impressed. Posterior adductor scar slightly buttressed. Accessory musculature deeply impressed, consisting of an elongate median scar, 4 small scars between this and the posterior of the umbonal cavity, a central scar below the median scar, and 6-8 prominent punctiform scars between the central scar and the anterior adductor. Inner ventral margins smooth. Pallial line simple. Exterior ornament consisting of fine concentric growth lines.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Holotype	CPC9198	34	25	20	6 (1 valve)
Paratype	CPC9201	38	30	24	15
"	CPC9199	30	22	19	9
"	CPC9200	22	17	14	8

Remarks: Leionucula doncasterensis sp. nov. resembles the European Neocomian and Aptian species Leionucula planata (Deshayes) as figured by Gardner (1884, pl.5, figs 1-4) and Woods (1899, pl.2, figs 11-15), but is less angular posteriorly.

The accessory (pedal) musculature of L. doncasterensis resembles that of the living species Nucula obliqua Lamarck, illustrated by Schenck (1934, pl.3, fig. 4). However, L. doncasterensis has additional muscle scars behind the median scar and within the umbonal cavity. Nucula obliqua Lamarck, the type species of Ennucula Iredale, is considered to be congeneric with Leionucula. In L. quadrata the median and central scars are fused and the punctiform scars are fewer.

Occurrence:

Doncaster Member: GAB1137; GAB1145; GAB2159; BMR Richmond 2 (153'4" -153'4½").

Jones Valley Member: GAB1139.

Age: Late Aptian.

Leionucula cooperi (Moore), 1870

Pl.36, figs 1-4

Synonymy:

1870 Nucula cooperi Moore, p.254, pl.12, fig.8.

1870 Nucula truncata Moore, p.254, pl.12, fig.9, non Daudin, 1801, Nilsson, 1827, nec Brown, 1827.

1889 Nucula truncata Moore; Tate, p.230.

1892 Nucula cooperi Moore; Etheridge Jnr, p.469, pl.34, fig.11.

1892 Nucula truncata Moore; Etheridge Jnr, p.469, pl.33, fig.9.

1902a Nucula truncata Moore; Etheridge Jnr, p.24, pl.3, figs 17-20; pl.6, figs 6-7.

1902a Nucula cooperi Moore; Etheridge Jnr, p.25.

1902a Isocardia ? tatei Etheridge Jnr, p.32, pl.3, fig.27; pl.4, figs 13-14.

1927 Nucula truncata Moore; Finlay, p.522.

1927 Nucula cooperi Moore; Finlay, p.522.

1966 Nucula cooperi Moore; Ludbrook, pl.14, figs 1-5.

Types: Nucula cooperi Moore. Holotype: Lost. Locality: "Wollumbilla", Doncaster Member, upper Aptian. Neotype: CPC 9202, an internal mould of a specimen with closed valves. Locality: SB129, Doncaster Member, upper Aptian.

Nucula truncata Moore. Holotype: Lost. Locality: "Wollumbilla", Doncaster Member, upper Aptian.

Material: Ten internal and external moulds of closed and separated valves.

Specific diagnosis: Thick shelled, trigonal shaped Leionucula, with prominent, strongly inflated umbones situated three-quarters of shell length from the anterior; dorsal margins forming angle of about 100° at the beak.

Description: Medium sized (length 15-25mm). Thick shelled. Trigonal shaped. Equivalve. Inequilateral. Strongly inflated. Umbones high and prominent; beaks opisthogyral, situated three-quarters of shell length from anterior end. Lunule and escutcheon well defined. Dorsal margins forming an angle of about 100° at the beak. Posterior almost vertically truncate. Ventral margins evenly rounded, meeting the dorsal well below mid-height. Chondrophore prominent, oblique;

directed anteriorly. Anterior tooth row with about 12 chevron shaped teeth. Posterior tooth row with about half as many teeth. Adductor muscle scars erectly ovate, subequal. Pedal musculature obscure in this material. Inner ventral margins smooth. Pallial line simple. Exterior with fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
F35627 UQ	21	17	16	-
CPC9202	17	13	14	11
CPC9203	16	13	15	12

Remarks: Moore's types were lost in the "Garden Palace" fire in Sydney in 1882 (Etheridge Jnr, 1892, p.xvi). As no suitable topotypic specimen is available, the neotype is now selected from well preserved material from SB129. This locality on the Maranoa River lies at approximately the same stratigraphic horizon as "Wollumbilla". The neotype closely resembles the internal moulds figures by Moore (1870, pl.12, figs 8-9). Moore described the umbones of this species as anterior. The present specimens exhibit traces of accessory (pedal) muscle scars on the longer end. Following Driscoll (1964) these are taken to indicate the anterior. Leionucula cooperi is thus a normal nuculid in which the anterior is longer than the posterior. Ludbrook (1966, p.147) compared Moore's species with Nucula pectinata Sowerby and N. gaultina Gardner, but these forms have crenulate inner margins and are generically distinct.

Leionucula cooperi (Moore) differs from L. quadrata Etheridge Snr, and L. doncasterensis sp. nov. in its more trigonal shape and greater inflation. In these features L. cooperi approaches species of Palaeonucula. The Indian Upper Jurassic species P. stoliczkai described by Cox (1940, p.20, pl.3, figs 21-23) as intermediate between Palaeonucula and Leionucula is especially similar.

Occurrence:

Doncaster Member: "Wollumbilla" (Moore, 1870); SB129; SB130.

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a) and several localities reported by Ludbrook (1966).

Age: Late Aptian.

Leionucula cf. cooperi (Moore)

Material: About 100 internal and external moulds.

Description: Very small, average length 3mm, average height 2mm. Trigonal shaped; strongly inflated. Equivalve. Inequilateral. Umbones slightly posterior; beaks small, opisthogyral. Dorsal margins arched, forming an angle of about 110° at the beak. Ventral margin evenly rounded. Dentition taxodont, anterior tooth row slightly longer than the posterior row. Chondrophore obscure. Adductor and pedal musculature not observed. Pallial line simple. Ornament consisting of fine, concentric growth lines.

Remarks: These small specimens are possibly only juvenile forms of Leionucula cooperi (Moore). However, they are tentatively separated as individuals of intermediate size have not yet been observed. If these forms are representatives of L. cooperi, that species is by far the most commonly occurring nuculid in the Albian of the Eromanga and Surat Basins.

Occurrence:

Doncaster Member:GAB2089.

Jones Valley Member: GAB693.

Coreena Member: GAB1936; GAB2056; GAB2079.

Allaru Mudstone: GAB1041; GAB1042; GAB1103; GAB1230; GAB1615; GAB1770; GAB1931; GAB1934; GAB1935; GAB2012; GAB2028; GAB2033; GAB2034; GAB2049; GAB2051; GAB2067; BMR Longreach 2 (91'9"-118'1"-119'); BMR Longreach 4 (69'3"-69'4").

Mackunda Formation: GAB674; GAB678; GAB834; GAB930; GAB1204; GAB1214; GAB1367; GAB1415; GAB1423; GAB1430; GAB1600; GAB1616; GAB1930; Ju2.

Age: Late Aptian - Early late Albian.

Superfamily NUCULANACEA H. & A. Adams, 1858

Family Nuculanidae H. & A. Adams, 1858

Remarks: It has been common practice among palaeontologists to refer the externally ligamented Cainozoic nuculacean genera to the Malletiidae, and the pre-Tertiary forms to the Ctenodontidae. Indeed Cox (1940, 1959) thought the position of the ligament was of paramount importance in phylogenetic studies of this group. He considered that the Cainozoic Malletiidae were directly derived from the Palaeozoic and Mesozoic Ctenodontidae; forms with an external ligament represented an uninterrupted succession from early Palaeozoic times to the present day. This view may be challenged on a number of grounds.

McAlester (1964) noted that the Ctenodontidae include a heterogeneous assemblage of forms united only by their common possession of an external ligament. Likewise, genera referred to the Malletiidae have external ligaments, but few resemble Malletia very closely.

Yonge (1939) demonstrated that the living genus Malletia possesses the same basic anatomy as living representatives of the Nuculanidae. He suggested that the Malletiidae should either be abandoned, or made a subtaxon of the Nuculanidae.

Studies by Trueman (1952), Owen et al. (1958) and Owen (1959) have shown that there is no fundamental difference between internal and external ligaments. In an internal ligament, the inner ligament layer (analogous to the inner shell layer), instead of lying beneath and in contact with the outer ligament layer (analogous to the outer shell layer), becomes separated from it and is contained in a pit which interrupts the dentition below the umbo. McAlester (1964) considered that an internal or "separated" ligament may have evolved independently in different lineages, and discounted the value of the feature in tracing phylogeny.

Furthermore, the tendency noted by Bernard (1896) for the initially internal ligament in Nuculana and Yoldia to emerge during ontogeny raises the possibility that externally ligamented genera may have arisen from forms with internal ligaments. Thus there is little justification for the assumption of fundamental stability for the position of the inner ligament layer.

The families Nuculanidae and Malletiidae defined in terms of the position of the inner ligament layer are rather unnatural and arbitrary associations of genera. Two of the genera discussed below have external ligaments. Mesosaccella Chavan resembles Saccella Woodring in general shell morphology and was included by Vokes (1967, p.130) in the Nuculanidae. Perrisonota Conrad approaches Nuculana Link in form, but was assigned to the Malletiidae by Vokes (1967, p.131).

For these reasons the diagnosis of the family Nuculanidae is now emended to include genera with external ligaments. As defined herein the family Nuculanidae includes genera more or less elongate in outline, with submedian or anterior umbones; posterior frequently pointed or rostrate and sometimes gaping; shell porcellanous in Recent forms, internally nacreous in certain fossil forms; taxodont dentition; hinge usually with an internal or "separated" ligament housed in chondrophore, but some forms with an entirely external ligament; pallial line sinuate in Recent genera, simple in some fossil representatives.

The Nuculanidae may be conveniently subdivided into two subfamilies, Nuculaninae and Polidevciinae Kumpera, Prantl and Ruzicka. The Palaeozoic Polidevciinae as diagnosed by Waterhouse (1965, p.637) may be distinguished from the Mesozoic-Recent

Nuculaninae by their possession of umbonal pedal muscle scars on an internal rib below the umbones.

The Palaeozoic Ctenodontidae are apparently more closely related to the Nuculacea and were included in that superfamily by Vokes (1967, p.125).

Subfamily Nuculaninae H. & A. Adams, 1858

Remarks: Living members of this group have porcellanous shells, all are siphonate to a greater or lesser extent, and have rather specialized feeding habits. Several of the older Mesozoic (Triassic and Jurassic) representatives deviate from this pattern. Some, like *Ryderia* Wilton, have internally nacreous shells; the pallial line is entire in certain forms such as *Praesaccella* Cox; and fossilized intestines of *Dacryomya* Agassiz described by Cox (1960a) indicate less specialized feeding habits. A considerable evolutionary advance occurred late in the Mesozoic as Cretaceous genera more closely resemble the Cainozoic forms.

Genus *Nuculana* Link, 1807

(= *Leda* Schumacher, 1817)

Type species (by monotypy): *Arca rostrata* Gmelin, 1791, Recent, northern coasts of Europe.

Generic diagnosis: Shell medium sized. Transversely elongated. Inequilateral. Umbones obtuse, situated one-third of shell length from the anterior. Posterior rostrate and slightly gaping. Rostrum bicarinate. Escutcheon weakly impressed. Lunule more distinct than escutcheon. Dentition taxodont. Hinge teeth chevron-shaped, the posterior series about twice as long as the anterior series. Chondrophore small, asymmetric, inclined posteriorly. Pallial sinus shallow, its apex narrowly U-shaped. Exterior with concentric growth lines only.

Range: ? Tertiary - Recent.

Remarks: In a broad sense, Nuculana has been employed as a generic name for partially identifiable, posteriorly elongated taxodonts, ranging in age from Silurian to Recent. However, in its restricted sense, the genus is peculiarly characteristic of Recent northern seas. Its representation in deposits older than Pliocene is doubtful.

"Nuculana" minmiensis Day described below is only referred to Nuculana s.l.

"Nuculana" minmiensis Day, 1967

Synonymy:

1927 Nuculana elongata (Etheridge Snr); Whitehouse, p.146.

1960 Malletia elongata (Etheridge Snr); Day, p.311.

1964 Neilo randsi (Etheridge Jnr); Day, table 3 (pars.).

1967b "Nuculana" minmiensis Day, p.9, pl.1, figs 10-14, text fig.2.

Types: Holotype: F35512 UQ. Paratypes: F35667 UQ, F7844 GSQ, F7845 GSQ. Locality: Holotype, RD99. Paratypes F35667 UQ, RD99; F7844 GSQ, L270; F7845 GSQ L272. All specimens from the Minmi Member, lower Aptian.

Material: About 30 specimens preserved as internal and external moulds.

Specific diagnosis: Transversely elongate "Nuculana"; length almost twice height;umbones situated in anterior one-third of shell; escutcheon well impressed; carina weak; ornament of very fine concentric growth lines.

Description: Small to medium size (length 10-30mm). Inequilateral. Weakly inflated and produced posteriorly. Transversely elongate, length almost twice height. Umbones obtuse, situated in the anterior one-third of shell. Antero-dorsal margin weakly arched, merging imperceptibly with the convex anterior end of the shell. Postero-dorsal margin gently concave. Ventral margin gently convex, rising posteriorly to meet the postero-dorsal margin in the dorsal quarter of the shell. Escutcheon deeply impressed, approximately at right angles to the plane of the hinge; bounded by a very weak carina which extends from the umbo to the postero-dorsal extremity; posterior portion of carina underlain on flank by slight sulcus. Hinge with numerous taxodont teeth, the larger ones distinctly chevron shaped; anterior row shorter than posterior row, with approximately 12-14 teeth; posterior row with about 20 teeth which occupy most of the postero-dorsal margin; teeth diminish rapidly in size near the umbo. Chondrophore obscure, very small. Anterior adductor scar more strongly impressed than the posterior. Some specimens with a small elongately oval pedal adjustor scar just anterior to the umbo. Pallial characters not visible. Ornament of very fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype, F35512 UQ	27	9	14	4 (1 valve)
Paratype, F35667 UQ	19	7	10	-
Paratype, F7844 GSQ	16	5	7	3 (1 valve)
Paratype, F7845 GSQ	19	6.5	10	-

Remarks: During preliminary examination this species was referred to *Malletia elongata*, a combination used by Etheridge Jnr (1902a,b) for *Leda elongata* Etheridge Snr (1872) and its supposed synonym *Nuculana* (? *Yoldia*) *randsi* Etheridge Jnr (1892). Finlay (1927) suggested *Neilo randsi* as the correct name. Subsequent examination of the lectotype of *Nuculana randsi* (F1410 GSQ) from "the Isis River, near the Bundaberg road", figured by Etheridge Jnr (1892, pl.26, fig.10) and that of *Leda elongata* (F1247 QM) from "Maryborough", figured by Etheridge Snr (1872, pl.20, fig.5), has revealed that "*Nuculana*" *minmiensis* has more anterior umbones than either of the Maryborough specimens.

The anterior umbones, ornament, teeth and to some extent the ligament features of "*N*". *minmiensis* are comparable with those of the genus *Nuculana* *s.s*. Differences occur in the nature of the rostrum and escutcheon. The type species of *Nuculana* has a bicarinate rostrum and a weakly impressed escutcheon visible in lateral view. In "*N*." *minmiensis* the escutcheon cannot be seen in this view, and there is only a single, weakly impressed carina. Furthermore, the pallial characters of _N_. _minmiensis_ are not known. At present the species seems best referred to _Nuculana_ _s.l_.

Leda _angulatostriata_ described by Sokolov and Bodylevsky (1931, pl.12, figs 4-6) and Weir (1933, fig.14) from the Aptian of Spitsbergen has similar anterior umbones, carinal and rostral features, but is not as posteriorly elongate and has a different ornament.

Nuculana _hoelscheri_ Cox (1961) from the Nanutarra Formation of Western Australia has anterior umbones like _N_. _minmiensis_, but its ornament of concentric rugae is strikingly different.

The loosely diagnosed and poorly figured species _Leda australis_ Moore (1870, p.251, pl.12, fig.7) from "Wollumbilla", which Etheridge Jnr (1892,p.469) referred to the genus _Nuculana_, is probably best regarded as a _nomen_ _dubium_, as Moore's specimen is apparently no longer extant.

Occurrence:

Minmi Member: SB228; RD78; RD82; RD94; RD99; RD109; RD128; RD207; RD285; L148 GSQ; L270 GSQ; L272 GSQ; R199, parish of Euthulla (Whitehouse, 1927).

Age: Early Aptian.

Genus _Mesosaccella_ Chavan, 1946

Type species (by original designation): _Nucula_ _forsteri_ Müller, 1847, Senonian, Northern Germany.

Generic diagnosis: Shell medium sized. Transversely elongated.

Equilateral. Umbones subcentral. Posterior rostrate, sharply pointed. Postero-dorsal margins concave. Hinge with subequal anterior and posterior rows of small, chevron shaped teeth. Ligament external. Pallial characters obscure. Exterior with concentric lamellae and growth lines.

Range: Cretaceous.

Remarks: In outline, Mesosaccella Chavan (1946) closely resembles the Tertiary-Recent genus Saccella Woodring (1925), but the former is clearly distinguished by its external ligament. Holzapfel (1889, p.202) reported that the pallial line of "Leda" forsteri (Müller) (the type species of Mesosaccella) was entire. However, his illustrations do not depict the pallial features. Mesosaccella randsi (Etheridge Jnr) described below has a well developed pallial sinus.

The Triassic genus Phaenodesmia Bittner (1895) has an external ligament like Mesosaccella, but is more inequilateral and has a differently shaped rostrum.

Palaeontologists have been slow to accept Chavan's genus. Nevertheless, the form is apparently widely distributed. In addition to the Australian Aptian and Albian occurrences reported herein, species of Mesosaccella have been recorded from the Lower and Upper Cretaceous of Western Europe (Chavan, 1946) (Casey, 1961c), the Upper Cretaceous of the Middle East (Chavan, 1947) and the Lower Cretaceous of Japan (Hayami, 1965a).

Mesosaccella randsi (Etheridge Jnr), 1892

Pl.36, figs 19-21

Synonymy:

1892 Nuculana (? Yoldia) randsi Etheridge Jnr, p.566, pl.26, fig.10.

1901 Malletia randsi (Etheridge Jnr), p.25.

1964 Neilo randsi (Etheridge Jnr); Day, table 3 (pars.).

1966a Phaenodesmia randsi (Etheridge Jnr); Fleming, p.9, pl.4, figs 9-13.

Type: Holotype: F1410 GSQ. Locality: "Isis River, near Bundaberg road, Wide Bay, "Maryborough Formation, Aptian.

Material: About 50 internal and external moulds and a few isolated specimens that retain shell material.

Specific diagnosis: Small to medium sized, well inflated Mesosaccella; length about 1.7 times height; postero-dorsal and ventral margins meeting in the dorsal third of the shell; escutcheon deeply impressed; carina weak; pallial sinus wide, U-shaped and moderately deep.

Description: Small to medium size (length 10-30mm). Almost equilateral. Well inflated. Transversely elongated; length about 1.7 times height. Anterior broadly rounded. Posterior rostrate, sharply pointed. Antero-dorsal margins gently convex, merging imperceptibly with the convex anterior end of the shall. Postero-dorsal margins concave, sloping. Ventral margins broadly rounded, rising to meet the postero-dorsal margin in the dorsal one-third of the shell. Umbones obtuse, subcentral, slightly in front of mid-length. Lunule indistinct. Escutcheon deeply impressed, approximately at right angles to the plane of the hinge; bounded by a weak carina which extends from the umbo to the postero-dorsal extremity. Hinge with numerous small, chevron-shaped teeth; anterior tooth row slightly shorter than the posterior. No chondrophore. Ligament external, opisthodetic. Musculature faintly impressed; adductor muscle scars small, suboval, dorsally situated. Pallial line with a wide, moderately deep, U-shaped pallial sinus. Pedal musculature not observed. Exterior ornamented with fine, closely spaced, concentric lamellae and growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype F1410 GSQ	30	14	18	5 (1 valve)
CPC9329	20	9	12	3 (")
CPC9256	14	6	8	2 (")

Remarks: Specimens from the Great Artesian Basin agree closely with the holotype of "Nuculana" randsi from "Maryborough", recently redescribed and refigured by Fleming (1966a, p.9, pl.4, figs 13a-b). Fleming demonstrated that the species lacked a chondrophore, and referred it to the externally ligamented Triassic genus Phaenodesmia Bittner (1895). However, this is a more inequilateral form with a differently shaped rostrum. "Nuculana" randsi corresponds more closely in outline to the externally ligamented Cretaceous genus Mesosaccella Chavan (1946).

The type species of Mesosaccella, M. forsteri (Müller) from the Senonian of the Aachen district of Germany was well figured by Holzapfel (1889, pl.21, figs 13-16). It closely resembles M. randsi (Etheridge Jnr).

The externally ligamented species "Nuculana" lineata (Sowerby) figured by Woods (1889, pl.1, figs 28-32) from the Lower and Upper Greensands of England, and "Nuculana" mariae (d'Orbigny) figured by Woods (1899, pl.1, figs 25-27) from the Gault of England, are also very similar.

Etheridge Jnr (1902a, p.26) regarded his species "Nuculana" randsi as a synonym of "Leda elongata" Etheridge Snr (1872). Fleming (1966a) re-examined the types and has shown that this view is incorrect. "Leda elongata" Etheridge Snr is more produced posteriorly than Mesosaccella randsi, has less arched ventral margins, and the postero-dorsal and ventral margins meet in line with the umbones. Etheridge Snr's name is preoccupied and the species is described below as Perrisonota etheridgei nom. nov.

Occurrence:

Doncaster Member: GAB2152; GAB2162; GAB2163; L98 GSQ; BMR Richmond 1 (265'5"-265'6½")?; BMR Richmond 2 (257'2"-257'2½).

Maryborough Formation: "Isis River near Bundaberg Road, Wide Bay" (Etheridge Jnr, 1892); "Corporation Quarry" and "Urraween Railway Station" (Fleming, 1966a).

Coreena Member: GAB1936; GAB2107; GAB2108; SB101.

Ranmoor Member: BMR Richmond 1 (85'-85'1½"; 93'-93'1").

Allaru Mudstone: GAB1041; GAB1221; GAB2018.

Mackunda Formation: GAB624; GAB764; GAB1329; GAB1353; GAB1360; GAB1368; GAB1500; GAB1616.

Age: Late Aptian - early late Albian.

Genus *Perrisonota* Conrad, 1869

Type species (by original designation): *Perrisonota protexta* Conrad, 1869, Upper Cretaceous, Eastern U.S.A.

Generic diagnosis: Medium sized. Weakly inflated. Transversely ovate and posteriorly rostrate. Tip of rostrum in line with the umbones. Very inequilateral. Umbones small, usually situated in the anterior one-quarter of shell. Hinge with anterior and posterior rows of small, chevron-shaped teeth; posterior tooth row very long, extending almost to the posterior extremity of the hinge line. No chondrophore. Ligament external. Pallial features obscure. Ornament of fine, concentric lamellae and growth lines.

Range: Cretaceous.

Remarks: *Perrisonota* Conrad (1869) approaches the form of *Nuculana* *s.s.* but as noted by Stewart (1930) the ligament of the former is external. The lack of a chondrophore is also readily apparent from the figures of the type species given by Whitfield (1885, pl.11, fig.15).

Gardner (1916, p.522) remarked that the pallial features of the genus were unknown. *Perrisonota etheridgei* nom. nov. described below has a deep pallial sinus.

Perrisonota has previously been reported from Eastern U.S.A.

(Gardner, 1916) and Europe (Stewart, 1930).

Perrisonota etheridgei nom. nov.

Pl.36, figs 22-26

Synonymy:

1872 Leda elongata Etheridge Snr, p.341, pl.20, fig. 5. (non Leda elongata Sowerby, 1832.

1892 Adrana elongata (Etheridge Snr); Etheridge Jnr, p.566, pl.33,fig.8.

1902b Malletia elongata (Etheridge Snr); Etheridge Jnr, p.25, pl.2, figs 6-8.

1927 Neilo randsi (Etheridge Jnr); Finlay, p.523.

1964 Neilo randsi (Etheridge Jnr); Day, table 3 (pars.).

1966a Phaenodesmia elongata (Etheridge Snr); Fleming, p.8, pl.4, figs 1-8.

1967 Yoldia freytagi Ludbrook; Skwarko, p.15, pl.1, figs 4-5.

Type: Holotype: F1247 QM. Locality: "Maryborough", Maryborough Formation, Aptian.

Material: About 30 internal and external moulds of isolated valves, several separated valves retaining shell material, and a single specimen with closed valves.

Specific diagnosis: Moderately inflated Perrisonota with umbones situated in the anterior one-third of shell; length about twice height; posterior dorsal margin concave; tip of rostrum upturned; escutcheon deeply impressed; carina sharp; posterior tooth row occupying only two-thirds of posterior dorsal margin; ornament consisting of broadly spaced concentric lamellae and fine concentric growth lines.

Description: Medium sized. Equivalve; not gaping. Moderately inflated. Very inequilateral. Transversely elongated, length about twice height. Posterior rostrate; tip of rostrum in line with the umbones. Anterior broadly rounded. Antero-dorsal margin almost straight, very slightly sloping. Postero-dorsal margin gently concave, sloping slightly. Ventral margins almost straight anteriorly, rising posteriorly to meet the postero-dorsal margin in line with the umbones. Umbones obtuse, situated about one-third of shell length from the anterior end. Lunule small. Escutcheon deeply impressed, lanceolate, approximately at right angles to the plane of the hinge; escutcheon bounded by a fairly sharp carina extending from the umbo to the postero-dorsal extremity. Hinge with numerous, small, chevron-shaped taxodont teeth arranged in anterior and posterior rows; posterior tooth row much longer than the anterior, occupying about two-thirds of postero-dorsal margin. No chondrophore. Ligament external. Musculature not visible in this material. Pallial line with a wide, deep sinus. Ornament consisting of weakly elevated, broadly spaced, concentric lamellae, and fine concentric growth lines.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Holotype	F1247 QM	15+	-	8	-
	F9231 GSQ	38	13	18	10
	F9195 GSQ	24	8	12	3 (1 valve)
	CPC9257	24	8	12	3 (")
	CPC9258	33	11	16	5 (")

Remarks: The original illustration of the incompletely preserved holotype of Leda elongata Etheridge Snr (1872, pl.20, fig.5) non Sowerby (1832) was poor, and did not give a clear indication of the species. Etheridge Jnr (1902a, p.26) concluded that the species was a senior synonym of his Nuculana randsi as the two occur in the same beds. Finlay (1927, p.523) accepted this and proposed that the pre-occupied name Leda elongata Etheridge Snr, be replaced by Etheridge Jnr's junior synonym, and transferred the species to the Tertiary-Recent genus Neilo Adams.

Finlay's proposal was adopted in a preliminary report by Day (1964, table 3). However, included under the name Neilo randsi (Etheridge Jnr) were specimens from the Minmi Member subsequently referred to "Nuculana" minmiensis Day (1967b,p.9, pl.1, figs 10-14, text fig. 2), and a few specimens from the Doncaster Member now identified as Mesosaccella randsi (Etheridge Jnr).

Fleming (1966a,p.8, pl.4, figs 1-8) has recently redescribed "Leda elongata" Etheridge Snr from the holotype and well preserved topotypes, and has shown that the species is clearly distinct from "Nuculana" randsi Etheridge Jnr. He also demonstrated that "Leda elongata" lacked a chondrophore and referred it to the externally ligamented Triassic genus Phaenodesmia Bittner (1895). However, Fleming did not rename Etheridge Snr's primary homonym. The posterior elongation and rostrum of "Leda elongata" Etheridge Snr accord more with those features of the Cretaceous genus Perrisonota Conrad (1869) and the species is now renamed Perrisonota etheridgei nom.nov.

The late Cretaceous type species of Perrisonota, P. protexta Conrad was well figured by Whitfield (1885, pl.11, figs 14-15) and closely resembles P. etheridgei nom. nov., but has slightly more anterior umbones and the posterior tooth row extends further towards the posterior extremity of the hinge line.

"Nuculana" solea d'Orbigny figured by Woods (1899, pl.1, figs 18-24) from the Gault of England, and which was referred to Perrisonota by Stewart (1930), is also similar.

"Nuculana" minmiensis Day has anterior umbones like Perrisonota etheridgei nom. nov., but the former has a small chondrophore, the tip of the rostrum lies below the line of the umbones, and the ventral margin is more convex.

The distinction of Perrisonota etheridgei from Mesosaccella randsi has already been discussed.

Specimens described from Aptian sediments of the Gibson Desert of Western Australia by Skwarko (1967, p.15, pl.1, figs 4-5) and referred to the Albian species Yoldia freytagi Ludbrook, are conspecific with Perrisonota etheridgei.

Occurrence:

Doncaster Member: GAB1075?; GAB1137; GAB2118; SB129; L98 GSQ; L100 GSQ; RD87; RD198; RD222.

Jones Valley Member: GAB687; GAB693; GAB1139.

Maryborough Formation: "Maryborough" (Etheridge Snr, 1872).

N.S.W.: "Dunlop holding, Darling R." and "well sinking on Mt Stuart

E. block" (Etheridge Jnr, 1902b).

W. Aust.: Gibson Desert (Skwarko, 1966).

Age: Late Aptian.

Genus *Yoldia* Moller, 1842

Type species (by subsequent designation I.C.Z.N. Opinion 769, 1966): *Yoldia hyperborea* Torell, 1859, Recent, Northern Atlantic.

Generic diagnosis: Shell moderately large. Transversely elongated, subovate. Posterior rostrum wide, poorly defined, generally non-carinate. Beaks subcentral or slightly posterior. Hinge with sub-equal, anterior and posterior rows of small, chevron-shaped teeth. Chondrophore large and triangular, extending below the tooth rows. Pallial sinus deep and wide, its apex broadly U-shaped. Exterior with concentric growth lines only.

Range: Cretaceous? Tertiary - Recent.

Remarks: The generic name *Yoldia* has been widely and loosely used for weakly inflated, subovate nuculanids which are only slightly rostrate posteriorly. *Yoldia s.s.* is a boreal genus (Woodring,1925). Its occurrence in pre-Tertiary deposits is doubtful.

"*Yoldia*" *freytagi* Ludbrook described below is only referred to *Yoldia s.l.*

"*Yoldia*" *freytagi* Ludbrook, 1966

Pl.36, figs 16-18

Synonymy:

1902a *Malletia elongata* (Etheridge Snr); Etheridge Jnr, pl.3, figs 21-23, ?24; ?pl.6, fig.14.

1966 Yoldia freytagi Ludbrook, p.148, pl.14, figs 13-14.

Types: Holotype: M1536 GSSA. Locality: Algebuckina 5/571/17, Maree Formation, Albian.

Material: About 100 internal and external moulds of separated valves.

Specific diagnosis: Usually small, transversely elongated "Yoldia"; length almost twice height; umbones situated in the anterior one-third of shell; posterior truncate, feebly rostrate; postero-dorsal margin straight, almost parallel to the ventral margins; escutcheon faintly impressed.

Description: Usually small. Equivalve. Inequilateral. Weakly inflated. Transversely elongated; length about twice height. Anterior broadly rounded; posterior truncate. Rostrum blunt without carina. Antero-dorsal margin straight, sloping; postero-dorsal margin straight, sloping slightly. Dorsal margins form an angle of about 160° at the umbones. Ventral margin very gently arched, almost parallel to the postero-dorsal margin. Posterior and postero-dorsal margins meet just below the line of the umbones. Umbones obtuse, situated in the anterior one-third of shell. Lunule ill-defined. Escutcheon weakly impressed. Hinge with anterior and posterior rows of small, chevron-shaped teeth, posterior row longer than anterior row. Position of ligament not observed in this material. Musculature faintly impressed. Pallial sinus wide and deep. Ornament consisting of broad, weakly elevated, widely spaced, concentric growth lamellae and fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype M1536 GSSA	22	7	11	7
CPC9330	17	6	8.5	3 (1 valve)
CPC9331	16	5	9	c.2 (")
CPC9897	14	5	8	3 (")
CPC9898	11	4	6	2 (")

Remarks: The present specimens compare closely with the holotype (M1536 GSSA) figured from Albian sediments of South Australia by Ludbrook (1966, pl.14, figs 13-14). She gave the range of "*Yoldia*" *freytagi* as Aptian-Albian. In Queensland, the species has been observed only in formations of Albian age. As noted above, specimens from Aptian sediments of the Gibson Desert of Western Australia figured by Skwarko (1967, p.15, pl.1, figs 4-5) as *Yoldia freytagi* are misidentified.

"*Yoldia*" *freytagi* Ludbrook has more anterior umbones than species of *Yoldia s.s.* and the presence of a large, triangular chondrophore has not been detected. For the present, Ludbrook's species seems best referred to *Yoldia s.l.*

Ludbrook (1966, p.149) compared her species with *Yoldia* ? *septariana* Craigin and *Y.* ? *subacuta* Stephenson, both from the Cenomanian of Texas. The former, figured by Stephenson (1952, pl.10, figs 14-16), is the closer relative, differing from "*Yoldia*" *freytagi* only in its more sloping dorsal margins which meet at an angle of about 145°.

Perrisonota etheridgei nom. nov. was confused with "Yoldia" freytagi Ludbrook by Skwarko (1967). The latter may be distinguished by its straight postero-dorsal margin, weakly impressed escutcheon, and non-carinate, rather bluntly terminated rostrum, the tip of which lies below the line of the umbones.

Occurrence:

Coreena Member: GAB1438; GAB2039; GAB2087; GAB2088; SB101.

Allaru Mudstone: GAB1041; GAB1103; GAB1228; GAB1935; GAB2008; GAB2028; GAB2033; GAB2034; GAB2067; BMR Longreach 2 (104'5"-159'2").

Mackunda Formation: GAB653; GAB671; GAB678; GAB1112; GAB1214; GAB1331; GAB1353; GAB1367; GAB1368; GAB2103. Maree Formation: Ludbrook (1966).

Age: Early - early late Albian.

Subclass PALAEOHETERODONTA Newell, 1965

Order TRIGONIOIDA Dall, 1889

Superfamily TRIGONACEA Lamarck, 1819

Family Trigoniidae Lamarck, 1819

Remarks: This family comprises basically triangular shaped shells which combine remarkable diversity in exterior ornamentation with exceptional stability in hinge features. The Myophoriidae, which are probably ancestral to the Trigoniidae (Cox, 1952), have similarly buttressed anterior adductors, somewhat similar dentition, and display sculptural diversity. Trigoniids may be distinguished by the combination of conspicuous transverse striations on all teeth, the width and prominence of the median cardinal tooth of the left valve (2b), and the hiatus in the hinge plate between the cardinal teeth (3a and 3b) of the right valve. Fleming (1964, p.197) claimed that the hiatus in the right valve hinge plate was unique to the family Trigoniidae. However, Dickins (1957, pl.5, figs 2 and 7) and Logan (1967, pl.8, fig.6) have figured species of the Permian myophoriid Schizodus which have an hiatus in the hinge plate.

The literature on fossil representatives of the Trigoniidae is quite voluminous. Cox (1952) has provided an excellent review of earlier work. Fleming (1964) has briefly discussed more recent contributions by Japanese and Russian authors. Several different subdivisions of the Trigoniidae into subfamilies have been suggested and the various proposals are summarized by Nakano (1961). At present there is little agreement on the nomenclature and content of these subfamilies. The subfamily grouping tentatively adopted here is essentially that of Kobayashi (1954).

The Trigoniidae first appeared in the Middle Triassic and reached their acme in the Jurassic and Cretaceous when the group was diverse in genera and species and cosmopolitan in distribution. Two genera from Australia, Eotrigonia and Neotrigonia provide the only Tertiary records of the family and a single species survives in Australian waters (Fleming, 1964).

Subfamily Trigoniinae Lamarck, 1819

Remarks: This subfamily includes trigoniids with concentric costae on the flank, a distinct marginal carina, and radial ribs on the area. The genera Eselaevitrigonia and Nototrigonia discussed below were included by Skwarko (1963) in a new subfamily, the Nototrigoniinae.

Genus Nototrigonia Cox, 1952

Type species (by original designation): Trigonia cinctuta Etheridge Jnr, 1902, Aptian, Great Artesian Basin.

Generic diagnosis: Small to medium size trigoniids. Somewhat pyriform and subrostrate posteriorly. Moderately inequilateral. Umbones not prominent, orthogyral. Area narrow, with a small number of radial ribs. Area separated from flank by a broad ante-carinal depression. Ante-carinal depression smooth in the left valve, sometimes bearing a few radial ribs in the right valve. Escutcheon carina well defined; escutcheon of moderate width, not impressed. Flank bearing moderately oblique, sinuous costae, which swell out and bend upwards near the anterior margin of the ante-carinal depression.

Range: Neocomian? - Albian.

Remarks: Nototrigonia Cox (1952, p.62) was a monotypic genus at the time of its proposal. Subsequently Skwarko (1963) described several additional species and amended Cox's generic diagnosis. Cox (1964) erected the subgenus Callitrigonia for Nototrigonia minima Skwarko. Nototrigonia s.s. is represented by N. cinctuta (Etheridge Jnr, 1902a), N. aberrata Skwarko (1963), N. crescenta Skwarko (1963), and possibly by N.? walkeri Skwarko (1966). "Trigonia" nasuta Etheridge Snr (1872) which Skwarko (1963) referred to Opisthotrigonia Cox

(1952) is possibly a further species of Nototrigonia s.s. The subgenus Callitrigonia is represented by N. minima Skwarko (1963), N. yeuralba Skwarko (1963) and N. nimbosa Skwarko (1966). Nototrigonia ponticula Skwarko (1963) is possibly generically distinct. Skwarko assigned all his species, except N. minima, a Neocomian age. However, the evidence for this is slender and they are probably Aptian species. Nototrigonia cinctuta and N. nasuta are Aptian forms, while N. minima is Albian in age.

Nototrigonia is at present an endemic genus. The South American Senonian species "Trigonia" hanetiana d'Orbigny and "T." ecplecta Wilckens were included in Nototrigonia by Skwarko (1963, p.25), but these seem best referred to the Senonian-Maestrichtian genus Pacitrigonia Marwick (1932). The latter resembles Nototrigonia, and as suggested by Fleming (1964, p.201), may be descended from it. Eselaevitrigonia Kobayashi & Mori (1954) has juvenile ornament like Nototrigonia, although the carina of the former is much narrower and the ornament quite distinct in the adult stage.

Subgenus Nototrigonia Cox, 1952

Subgeneric diagnosis: Comparatively large, with numerous, close set, sinuous flank ribs. No radial ornament in the ante-carinal depression.

Range: Neocomian? - Aptian.

Nototrigonia (Nototrigonia) cinctuta (Etheridge Jnr), 1902

Pl. 37, figs 14-15

Synonymy:

1902a Trigonia cinctuta Etheridge Jnr, p.28, pl.4, figs 4-6.

1907 Trigonia cinctuta Etheridge Jnr, p.322, pl.60, fig.9.

1952 Nototrigonia cinctuta (Etheridge Jnr); Cox, p.62, pl.4, fig.3.

1961 Nototrigonia cinctuta (Etheridge Jnr); Nakano, p.87, pl.8, fig. 15.

1963 Nototrigonia cinctuta (Etheridge Jnr), Skwarko, p.26, pl.3, figs 1-2.

1963 Nototrigonia sp. cf. N. cinctuta (Etheridge Jnr); Skwarko, p.28, pl.3, figs 3-5.

1964 Nototrigonia cinctuta (Etheridge Jnr); Fleming, fig.12.

1966 Nototrigonia cinctuta (Etheridge Jnr); Ludbrook, p.72.

1966 Nototrigonia sp. cf. N. cinctuta (Etheridge Jnr); Skwarko, p.101, pl.7, fig.13.

Type: Holotype: T1318 AUGD. Locality: Not accurately known, but presumably from the "Peake area" (Nilpinna 1-mile sheet), Marree Formation, Aptian.

Material: Three closed valves in varying stages of exfoliation, 2 left valves and an internal and external mould of closed valves.

Specific diagnosis: Medium sized; pyriform, produced posteriorly area with approximately 4 simple, unbeaded radial ribs; flank with numerous, closely spaced, sinuous costae.

Description: Medium size (length 30-60mm). Moderately inequilateral. Pyriform, produced posteriorly. Well inflated. Umbones broad, slightly opisthogyral. Marginal carina fairly prominent in early growth stages, fading later. Ante-carinal depression smooth but for concentric growth lines, shallow and very wide postero-ventrally. Hinge typically trigoniid. Umbonal pedal muscle scar represented in each valve by a small conical pit situated at the apex of the umbonal cavity. Adductor muscle scars small, subequal; anterior adductor scar situated on a prominent buttress. Pallial line simple. Interior near the posterior extremity with a siphonal ridge. Escutcheon ornament not visible in this material. Area with 4 prominent radial ribs and fine, transverse lines of growth. Flank ornamented with numerous, narrow, closely spaced, sinuous costae. Flank costae initially strongly oblique anteriorly, becoming concentric and thickening before terminating at the ante-carinal depression; termination of flank costae in later growth stages not visible in this material.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype T1318 AUGD	52	13	48	15 (1 valve)
CPC 9244	45+	13	35	12 (")
CPC 9332	44	12	30	10 (")

Remarks: The present specimens differ from the holotype only in their slightly less oblique flank ribbing. Specimens figured from the Northern Territory by Skwarko (1963, pl.3, figs 3-5) (1966, pl.7, fig. 13) and compared with Nototrigonia cinctuta are probably conspecific, although they do not appear to be as posteriorly rostrate.

Nototrigonia aberrata Skwarko (1963, p.31, pl.5, fig.5) (1966, p.100, pl.7, fig.4; pl.8, figs 1-2) from the Mullaman Beds, has sparser flank ribbing than N. cinctuta, while N. crescenta Skwarko (1963, p.29, pl.4, fig.8) (1966, p.101, pl.7, fig.5, text fig 7) is more produced posteriorly and has beaded radial ribs on the area.

Occurrence:

Doncaster Member: 'Sources of the Barcoo, Ward and Nive Rivers, South Central Queensland' (Etheridge Jnr, 1907); GAB2101.

Jones Valley Member: GAB699.

Coreena Member: GAB1933 (remanié occurrence)

Maree Formation: 'Peake area'.

Mullaman Beds: TT21 (Skwarko, 1963).

Age: Late Aptian.

Subgenus Callitrigonia Cox, 1964

Type species (by original designation): Nototrigonia minima Skwarko, 1963, Albian, Great Artesian Basin.

Subgeneric diagnosis: Small to medium sized; with prominent marginal carina. Ante-carinal depression smooth in the left valve, bearing a few radial ribs in the right valve.

Range: Neocomian? - Albian.

Nototrigonia (Callitrigonia) minima Skwarko, 1963

Pl.37, figs 12-13

Synonymy:

1963 Nototrigonia minima Skwarko, p.29, pl.3, figs 8-11.

1964 Nototrigonia (Callitrigonia) minima Skwarko; Cox, p.51, pl.2, figs 6-7.

1966 Nototrigonia (Callitrigonia) minima Skwarko; Ludbrook, p.73, pl.23, fig.4.

Types: Holotype: CPC4656. Paratypes: CPC4657, CPC4658 and CPC4659.

Locality: "western margin of the Great Artesian Basin, south-western Queensland", probably from Mackunda Formation, lower upper Albian.

Material: About 50 internal and external moulds of separated valves.

Specific diagnosis: Ovately oblong, produced posteriorly; marginal and escutcheon carinas broad and smooth; flank costae oblique, rather widely spaced, sinuous anteriorly; area with 4 prominent, smooth radial ribs; ante-carinal depression in the right valve bearing several fine, beaded radial ribs.

Description: Small to medium size (length 10-30mm). Ovately oblong, produced posteriorly. Moderately inequilateral. Umbones not elevated, orthogyral. Marginal and escutcheon carinas broad and smooth, fairly prominent. Dentition, adductor musculature, and pallial features typically trigoniid. Umbonal pedal muscle scar represented in each valve by a small conical pit situated at the apex of the umbonal cavity. Interior near posterior extremity with a siphonal ridge. Escutcheon ornamented with very fine, beaded radial ribs. Area comparatively wide, with 4 prominent, smooth radial ribs. Ante-carinal depression broad, smooth in the left valve, bearing several fine, beaded radial ribs in the right valve. Flank ornament consisting of oblique, rather widely spaced costae, sinuous anteriorly; flank costae considerably thickened at their termination in front of the ante-carinal depression.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype CPC4656	22	6	17	-
Paratype CPC4657	21	c.7	16	-
Paratype CPC4658	28	9	18	-
Paratype CPC4659	30	9	19	-
CPC9333	13	4	9	(1 valve)
CPC9359	25	6	14	(")

Remarks: Nototrigonia (Callitrigonia) minima Skwarko is similar in shape to N. (C.) yeuralba Skwarko (1963, p.30, pl.3, fig.6) (1966, p.100, pl.7, fig. 6), but the latter has finer costae on the flank and area.

Nototrigonia nimbosa Skwarko (1966, p.101, pl.7, figs 7,9,10), the only other described species of the subgenus Callitrigonia is more trigonal in outline, has a wider ante-carinal depression and the marginal and escutcheon carinas are tuberculate.

Skwarko (1963, p.29) gave the range of Nototrigonia minima as Aptian and Albian, but there are no confirmed Aptian records of the species. Ludbrook (1966, p.173) reported it from one Albian locality in South Australia, while specimens described by Cox (1964) are probably from the Albian Normanton Formation. In the present study N. (C.) minima has been observed only in the Allaru Mudstone and the Mackunda Formation.

Occurrence:

Allaru Mudstone: GAB1041; GAB1042; GAB1935?;GAB2033; GAB2050.

Mackunda Formation: "western margin of the Great Artesian Basin, south-western Queensland" (Skwarko, 1963); GAB653; GAB764; GAB815; GAB822; GAB823; GAB922; GAB1108; GAB1112; GAB1214; GAB1324; GAB1335; GAB1368; GAB1403; GAB1423?; GAB2100; Ju2.

Maree Formation: Nilpinna 5/581/2 (Ludbrook, 1966)

?Normanton Formation: "Donors Plateau where Burketown-Normanton road crosses Magoura Creek" (Cox, 1964).

Age: Early late Albian.

Genus Eselaevitrigonia Kobayashi & Mori, 1954

Type species (by original designation): Trigonia meridiana Woods, 1917, Ngaterian - Arowhanan Stages (Cenomanian - Turonian), New Zealand.

Generic diagnosis: Trigonal to elongate - ovate trigoniids. Moderately inequilateral. Area ornamented with fine radial ribs in the juvenile stage. Flank ornamented with broad or narrow, regularly or irregularly spaced, concentric or somewhat oblique, non-tuberculate ribs, which terminate at the ante-carinal depression in the juvenile stage, but continue across the marginal carina and area in the adult stage.

Range: Neocomian - Turonian.

Remarks: Kobayashi and Mori (1954, p.161) proposed *Eselaevitrigonia* for the species group represented by *Trigonia meridiana* Woods, *T. cardiniiformis* Kitchin, *T. trapeziformis* Kitchin, and *T. spissicostata* Kitchin. Cox (1952, p.62) referred these forms to *Laevitrigonia* Lebküchner (*ex* Deecke). However, the area of *Eselaevitrigonia* has radial ornament in early stages of growth, the concentric flank ribs are non-tuberculate, and in later stages of growth, concentric ribs pass from flank to area without interruption.

Eselaevitrigonia is an Indo Pacific genus with species known from the Neocomian of Kutch, India (Kitchin, 1903) and the Ngaterian and Arowhanan Stages (Cenomanian - Turonian) of New Zealand (Fleming, 1964). The gap in records of the genus between the Neocomian and the Cenomanian is reduced by the Aptian species, *Eselaevitrigonia lineata* (Moore), described below.

Eselaevitrigonia lineata (Moore), 1870

Pl.37, figs 16-20

Synonymy:

1870 *Trigonia lineata* Moore, p.255, pl.13, fig.12.

1879 *Trigonia lineata* Moore; Lycett, p.224.

1884 *Trigonia lineata* Moore; Tenison Woods, p.239.

1889 Trigonia lineata Moore; Tate, p.230.

1892 Trigonia lineata Moore; Etheridge Jnr, p.470.

?1902a Trigonia lineata Moore; Etheridge Jnr, p.28, pl.3, figs 25-26.

1927 Trigonia aff. nasuta Etheridge Snr; Whitehouse, p.146.

1954 Trigonia lineata Moore; Kobayashi & Mori, p.158.

1963 Laevitrigonia lineata Moore; Skwarko, p.16.

1963 Trigoniid gen. & sp. Skwarko, p.38, pl.6, fig.5.

1964 "Trigonia" lineata Moore; Day, table 3.

?1966 Laevitrigonia lineata Moore; Ludbrook, p.172, pl.23, figs 2,3,5.

Type: Holotype: Lost. Locality: "Wollumbilla". Neotype: here designated F7829 GSQ, an external mould of a right valve. Locality: RD122, Doncaster Member, upper Aptian.

Material: About 12 internal and external moulds of closed and separated valves.

Specific diagnosis: Trigonal shaped, length only slightly greater than height; area and escutcheon similarly ornamented, each with about 6 fine radial ribs and numerous fine transverse ribs in juvenile stages; flank ribs strong, narrow, regularly and closely spaced, oblique and flexed anteriorly.

Description: Medium size (length 20-50mm). Trigonal shaped; length only slightly greater than height. Well inflated. Moderately inequilateral, not produced posteriorly. Umbones broad, slightly opisthogyral. Hinge typically trigoniid. Adductor muscle scars small, subequal. Anterior adductor scar situated on a prominent buttress. Posterior pedal retractor inserted above and slightly in front of the posterior adductor scar. Umbonal pedal muscle scar in each valve represented by a small conical pit situated at the apex of the umbonal cavity, deeper in the left valve than the right. Ornament differently developed in the juvenile stage (up to height of 20mm) from that in the adult stage. Marginal carina, non-tuberculate, distinct in juvenile stage, broadening and fading in adult stage. Ante-carinal depression narrow and deep in juvenile stage, becoming wide and shallow later. Flank with numerous, strong, narrow, regularly and closely spaced, non-tuberculate concentric ribs, obliquely inclined and flexed anteriorly. Flank ribs in juvenile stage terminate at the ante-carinal depression. Flank ribs in mature stage cross the ante-carinal depression, bend slightly antero-dorsally on the marginal carina, and continue across the area as transverse ribs. Escutcheon carina indistinct, non-tuberculate. Escutcheon and area similarly ornamented in juvenile stage, each with about 6 fine radial ribs and numerous, fine transverse ribs corresponding to growth stages. Area in adult stage with transverse ribbing only.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Neotype F7829 GSQ	44	15	41	15 (1 valve)
F2559 GSQ	34	9	28+	12 (")
F35531 UQ	20	7	18	6 (")

Remarks: The holotype, an abraded left valve figured by Moore (1870, pl.13, fig.12) from "Wollumbilla", was destroyed by fire (Etheridge Jnr, 1892, p.xvi). The neotype now selected from topotypic material is an external mould of a right valve which closely corresponds to the specimen figured by Moore.

Skwarko (1963, p.16) referred Trigonia lineata to Laevitrigonia, but the present material reveals that the area is radially ornamented and the concentric ribs of later growth stages pass from flank to area without interruption. Thus T. lineata is more properly included in Eselaevitrigonia.

The type species of Eselaevitrigonia, Trigonia meridiana Woods (1917, p.6, pl.1, figs 2-7), has similar juvenile ornament. However, that species is more elongated posteriorly than "T." lineata and later growth stages bear only concentric furrows.

Exfoliated specimens from South Australia figured by Etheridge Jnr (1902a, pl.3, figs 25-26) and Ludbrook 1966, (pl.23, figs 2,3, and 5) are only doubtfully identified with Eselaevitrigonia lineata as their ornament is unknown.

Occurrence:

Doncaster Member: "Wollumbilla" (Moore, 1870); "Gammies Plains" (Whitehouse, 1927); RD87; RD90; RD92; RD122.

Maree Formation: "Lake Eyre Basin" ? (Etheridge Jnr, 1902a) and possibly several localities reported by Ludbrook (1966).

Age: Late Aptian.

Subfamily Myophorellinae Kobayashi, 1954

Remarks: This subfamily includes trigonally ovate or quadrate trigoniids with tuberculate, diagonal flank ribs, and a smooth or transversely ribbed area.

Genus *Myophorella* Bayle, 1878

Type species (by subsequent designation Crickmay, 1932): *Myophorella nodulosa* Bayle, 1878, Oxfordian, France.

Generic diagnosis: "Trigonally ovate to oblong, with slightly protruding umbones; strongly inequilateral. Marginal carina obtuse. Area transversely ridged or smooth, without radial ornament. Escutcheon shallow, of moderate width. Flank with costae which are usually oblique, but occasionally almost concentric, and which usually have an uneven surface or are broken up into tubercles" (Cox, 1952, p.55).

Range: Liassic- Lower Cretaceous.

Remarks: *Myophorella gallowayi* sp. nov. described below is not readily accommodated in any of the subdivisions of *Myophorella* recognised by Cox (1952) and Kobayashi & Tamura (1955). A new subgenus may be required for this species and a related form figured by Skwarko (1963, pl.5, figs 6-7) as *Myphorella* sp. nov.? (juvenile). However, the available specimens are limited in number, and all are small and possibly represent only immature growth stages. In view of this, proposal of a new subgenus is deferred pending the discovery of additional material.

Myophorella gallowayi* sp. nov.

Pl.37, figs 7-11

*Named after Mr M.C. Galloway of the Bureau of Mineral Resources, who collected the type specimens.

Types: Holotype: CPC9253, external mould of a left valve. Paratypes: CPC9254, external mould of a left valve; CPC9255, external mould of right valve; CPC9297, external mould of closed valves; CPC9352, internal mould of left valve. Locality: Paratype CPC9255, GAB813, Mackunda Formation, lower upper Albian. Holotype and other paratypes, GAB2028, Allaru Mudstone, lower upper Albian.

Material: The holotype, paratypes and 6 additional specimens.

Specific diagnosis: Small, somewhat quadrate; marginal and escutcheon carinas discontinuous, respectively represented by a row of prominent tubercles and a row of bar like ridges; areal ornament consisting of oblique ribs which resemble, and are only slightly offset from flank ribs; flank with numerous, narrow ribs which meet the marginal carina at a steep angle.

Description: Small (length 5-15mm). Somewhat quadrate. Markedly inequilateral. Moderately inflated. Umbones anterior, depressed, opisthogyral. Hinge and adductor scars typically trigoniid. Small umbonal pedal muscle scar present in the apex of the umbonal cavity in each valve. Marginal carina discontinuous, represented by a row of prominent tubercles. Escutcheon carina also discontinuous, represented by 6 bar-like transverse ridges. Escutcheon smooth.

Area with numerous oblique ribs which resemble, and are only slightly offset from flank ribs. Flank with numerous closely spaced ribs which diverge, thicken, and develop tubercles ventrally. Initial flank ribs steeply angled at the marginal carina, becoming almost concentric anteriorly, where the ribs are continued as rows of tubercles. Flank ribs almost vertical at mid-length. Both flank and area crossed by concentric growth lamellae.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype CPC9253	12	4	10	3 (1 valve)
Paratype CPC9254	13	4	12	3 (")
Paratype CPC9255	12	c.4	10	3 (")
Paratype CPC9297	9	3	-	5
Paratype CPC9352	14	5	13	4 (")

Remarks: *Myophorella gallowayi* sp. nov. is most closely related to *Myophorella* sp. nov.? (juvenile) described by Skwarko (1963, pl.5, figs 6-7) from the Windalia Radiolarite of Western Australia. The latter has a similar discontinuous escutcheon carina consisting of a row of transverse ridges, a marginal carina marked only by a row of tubercles and the ribs on the area are not sharply differentiated from those on the flank. The Western Australian species, which is probably of Aptian age, differs from *M. gallowayi* in its thicker flank ribs.

Occurrence:

Allaru Mudstone: GAB2028; GAB2053.

Mackunda Formation: GAB813.

Age: Early late Albian.

Subfamily Megatrigoniinae van Hoepen, 1929

Remarks: Following Nakano (1965) only two genera, *Megatrigonia* and *Iotrigonia*, are included in this subfamily. The marginal and escutcheon carinas of these forms are obscure, and the area is narrow and smooth except near the umbo where simple transverse ribs are developed. The early flank costae are concentric or nearly so, but in later stages of growth become diagonal, V- or L-shaped. Saviliev (1958) has recognised a monotypic subfamily Iotrigoniinae.

Genus *Iotrigonia* van Hoepen, 1929

Type species (by original designation): *Iotrigonia crassitesta* van Hoepen, 1929, Aptian, Zululand.

Generic diagnosis: Trigonally ovate or somewhat lunate. Inequilateral. Marginal and escutcheon carinas indistinct except in early growth stages. Escutcheon broad and smooth, sometimes with fine transverse ribbing near the umbo. Area narrow with fine transverse ribs in early growth stages, smooth later. Flank ribs plain, initially concentric or subconcentric, later becoming V- or L-shaped. Flank ornament frequently obsolete in later stages of growth.

Range: Upper Jurassic-Maestrichtian.

Remarks: Nakano (1965) has discussed the morphology and affinities of *Iotrigonia* at some length. *Iotrigonia* is essentially a South American and Indo-Pacific genus with a sparse Eurasian and North American representation.

Iotrigonia mackundaensis* sp. nov.

Pl.37, figs 1-6

*Named after the Mackunda Formation.

Types: Holotype; CPC9353, external mould of a medium sized left valve and part of its opposing right valve. Paratypes: CPC9354, internal and external mould of a small left valve; CPC9355, external mould of a large right valve; CPC9356, an external mould of a medium sized left valve; CPC9358, an internal mould of a medium sized right valve. Locality: Holotype, GAB1315. Paratypes: CPC9354, GAB1311; CPC9355, GAB1335; CPC9356, and CPC9358, GAB1215. All specimens from the Mackunda Formation, lower upper Albian.

Material: About 50 separated valves and a few closed valves, some retaining shell, but mostly preserved as internal and external moulds.

Specific diagnosis: Small to large, trigonally ovate Iotrigonia; umbones anterior; initial flank costae very fine, non-tuberculate, subconcentric, continued across the area up to a shell height of about 15mm; flank costae then become diagonal and develop an acute, postero-ventrally directed V; posterior limb of V nearly vertical, terminated at the marginal carina, similar in thickness to postero-ventral parts of the anterior limb of V; flank costae developed after shell height of approx. 25mm interrupted by broad, widely spaced, concentric depressions; flank ornament beyond shell height of approx.

35mm effaced, consisting of fine concentric growth lines only.

Description: Small to medium sized (length 10-50mm). Trigonally ovate. Thick shelled. Markedly inequilateral. Well inflated. Umbones anterior, not prominent, slightly opisthogyral. Marginal carina indistinct. Dentition, adductor musculature and pallial features typically trigoniid. Umbonal pedal muscle scar represented in each value by a small, conical pit, situated at the apex of the umbonal cavity. Escutcheon carina indistinct. Escutcheon narrow and smooth. Area narrow, initially with fine, transverse ribs which represent the continuation of flank costae. Area smooth after shell reaches height of approx. 15mm. Flank ornament as per specific diagnosis.

Dimensions:	Length	Anterior length	Height	Inflation
Holotype CPC9353	38	14	27	19
Paratype CPC9355	48+	14	47	12 (1 valve)
Paratype CPC9358	43	12	33	9 (")
Paratype CPC9356	31	10	24	8 (")
Paratype CPC9354	20	6	15	5 (")

Remarks: *Iotrigonia mackundaensis* may be distinguished from the closely allied species *I. hoepeni* Skwarko (1963, p.18, pl.1, figs 10-14, text fig. 1) (1966, p.98, pl.7, fig.12) from the Mullaman Beds, by its more ovate outline, and very fine initial flank costae. In addition the shells of *I. mackundaensis* attain a larger size before V-shaped ribs develop and flank ornament becomes obsolete.

Skwarko assigned his species a late Neocomian age, but the evidence for this is slender and the species is probably of early Aptian age. I. mackundaensis is a late Albian species peculiarly characteristic of the uppermost horizons of the Mackunda Formation in the Manuka, Tangorin and Muttaburra areas.

Skwarko (1963) proposed the subgenus Zaletrigonia for Iotrigonia hoepeni. However, Nakano (1965) has noted that the flank ornament of the type species of Iotrigonia, I. crassitesta van Hoepen, varies in the same way as that of I. hoepeni, and subgeneric separation of the two species seems unnecessary.

Iotrigonia mackundaensis sp. nov. has more anterior umbones and finer flank costae than I. crassitesta van Hoepen (1929, p.7, pl.2, figs 4-5, pl.3, figs 1-2).

Occurrence:

Mackunda Formation: GAB849?; GAB905; GAB1215; GAB1217; GAB1250; GAB1302; GAB1303; GAB1304; GAB1309; GAB1311; GAB1312; GAB1318; GAB1335.

Age: Early late Albian.

Subclass HETERODONTA Neumayr, 1884

Order VENEROIDA H. & A. Adams, 1858

Suborder LUCININA Dall, 1889

Superfamily CARDIACEA Lamarck, 1809

Family Lahilliidae Finlay & Marwick, 1937

Remarks: Finlay and Marwick (1937, p.30) proposed this taxon as a subfamily of the Cardiidae to house the genus *Lahillia* Cossmann. This genus differs from typical members of the Cardiidae in lacking radial ornament, crenulate shell margins and anterior lateral teeth, although its cardiid affinities are apparent from the shape, cyclodont arrangement of the cardinal teeth, strong posterior lateral teeth and nymphs. Marwick (1944) subsequently elevated the Lahilliinae to family rank.

Vokes (1967, p.272) listed only *Lahillia* and its subgenus *Lahilleona* Finlay and Marwick in the family Lahilliidae. Two additional genera, *Thetironia* Stoliczka (1870) and *Onestia* McLearn, are now referred to the family.

There has been considerable uncertainty concerning the family affinities of *Thetironia*. The writer agrees with Keen (1937, p.13), who suggested a relationship between *Lahillia* and *Thetironia*. The latter has cyclodont cardinals, non-crenulate interior margins, but lacks lateral teeth and develops faint radial ornament.

Onestia McLearn (1933) which was referred to the Cardiidae by Vokes (1967, p.267) has cyclodont cardinals, non-crenulate interior margins, and concentric ornament. However, some species of *Onestia*, including the type, have anterior lateral teeth.

The inclusion of Thetironia and Onestia in the Lahilliidae necessitates a broadening of Finlay and Marwick's concept of the group. The emended diagnosis is:- Small to quite large; cordate shaped; cardinal teeth cyclodont; anterior lateral teeth sometimes present; posterior lateral teeth usually developed; ligament external, opisthodetic, seated on prominent nymphs; inner margins non-crenulate; pallial line simple or with a broad, shallow sinus; ornament concentric, or concentric with a faint radial ribs.

The Lahilliidae may be distantly related to the tellinacean family Tancrediidae. Their shared features include concentric ornament, poorly developed anterior lateral teeth, smooth interior margins and the simple or slightly sinuate pallial line. However, these features are considered to be outweighed by the cardiacean characters of the Lahilliidae, such as the cordate shape and cyclodont cardinal teeth.

The oldest representatives of the Lahilliidae are Valanginian species of Thetironia from Europe and South Africa (Gillet, 1924). Thetironia is widely distributed in the Lower Cretaceous of Europe (Gillet, 1924) and also occurs in California (Stewart, 1930). The genus is not known above the Cenomanian. Onestia is found in the Albian of Western Canada, and the Aptian and Albian of Australia. Lahillia is the youngest genus of the family. It ranges from Senonian to Eocene, and occurs in Victoria, New Zealand, Antarctica, Chile and Patagonia.

Genus *Onestia* McLearn, 1933

Type species (by original designation): *Laevicardium onestae* McLearn, 1931, Albian, Alberta, Canada.

Generic diagnosis: Thick shelled. Small to large in size. Orbicular to subquadrate in shape. Subequilateral. Equivalve; well inflated. Umbones broad, slightly anterior. Hinge formula $\frac{\text{(AI) 3a 3b PI PIII}}{\text{(AII) 2 4b PII}}$; cardinal teeth cyclodont; anterior laterals subject to reduction; posterior laterals laminar or somewhat tuberculiform. Ligament external, opisthodetic, seated on prominent nymphs. Inner ventral margins smooth. Pallial line simple or with a broad, shallow sinus. Ornament consisting of fine, concentric growth lines and widely spaced concentric furrows marking growth halts.

Range: Aptian - Albian.

Remarks: McLearn (1933, p.152) proposed *Onestia* as a subgenus of *Integricardium* Rollier and cited *Laevicardium onestae* McLearn (1931, p.7, pl.1, fig.1) from the Albian Clearwater Formation of Alberta as type species. Subsequently McLearn (1945) assigned the taxon generic rank. The type species has been refigured by McLearn (1933, pl.2, figs 8-10) (1945, pl.3, fig.9) and Jeletzky (1964, pl.24, figs 9,11).

The original diagnosis of McLearn is emended above to accommodate the three Australian species now referred to *Onestia*. In *Onestia etheridgei* (Etheridge Jnr, 1892) and *Onestia augathellaensis* sp. nov., anterior lateral teeth are not developed, while in the former and Onestia wallumbillaensis sp. nov. a shallow, but distinct pallial sinus is developed. Onestia etheridgei and O. wallumbill-aensis could be separated subgenerically from Onestia, as Finlay and Marwick (1937) have done for the sinupalliate form of Lahillia.

McLearn (1933, p.152) compared Onestia with the Cretaceous genus Thetironia Stoliczka (1870). However, that form, as illustrated by Woods (1907, pl.25, fig.15; pl.26, figs 1-14), lacks lateral teeth and has faint radial ornament.

Onestia is closely related to the Senonian - Eocene genus Lahillia Cossmann, the latter differing principally in its more massive hinge plate and lack of anterior lateral teeth. Indeed, Onestia etheridgei and O. augathellaensis, which fail to develop anterior laterals, are possible ancestors of Lahillia.

At present Onestia is known only from the Albian of Western Canada, and the Aptian and Albian of Australia.

Onestia wallumbillaensis* sp. nov.

Pl.38, figs 11-13

*Named after the Wallumbilla Formation.

Synonymy:

1901 Cyrena (?) n. sp. Guerich, p.486, pl.19, figs 5-6.

1925 Gen. et sp. nov. Whitehouse, p.34, pl.1, fig.6.

1964 Unicardium ? etheridgei Etheridge Jnr; Day, table 3.

1966 Onestia etheridgei (Etheridge Jnr); Ludbrook, p.183, pl.23, fig.11.

Types: Holotype: F7848 GSQ, an internal mould of a postero-ventrally incomplete right valve. Paratypes: F7836 GSQ, an internal mould of a left valve; F9230 GSQ, an external mould of the dorsal part of a right valve. Locality: Holotype RD221. Paratypes RD122. All specimens from Doncaster Member, Upper Aptian.

Material: Fifteen internal and external moulds of separated valves.

Specific diagnosis: Medium sized, somewhat orbicular *Onestia* with strongly arched dorsal margins, weakly developed anterior lateral teeth, and a broad, shallow pallial sinus.

Description: Medium size (length 40-60mm). Equivalve; well inflated umbonally. Somewhat orbicular. Length greater than height. Subequilateral. Antero-dorsal margin straight and sloping. Postero-dorsal margin gently arched. Anterior, posterior and ventral margins evenly rounded. Umbones broad, moderately elevated. Beaks orthogyral, slightly anterior. Lunule ill defined. Escutcheon deep, lanceolate. Hinge plate thickened, bearing two cyclodont cardinal teeth in each valve. Hinge formula $\frac{\text{AI} \quad \text{3a} \quad \text{3b} \quad \text{PI} \quad \text{PIII}}{\text{AIII} \quad \text{2} \quad \text{4b} \quad \text{PII}}$. Left anterior cardinal (2) trigonal, prosocline, situated immediately in front of the beak. Left posterior cardinal (4b) behind the beak; smaller, opisthocline. Right anterior cardinal (3a) trigonal, projecting from the shell margin in front of the beak. Right posterior cardinal (3b) situated immediately below the beak, trigonal, distally pointed, slightly opisthocline. Anterior laterals AI and AIII weakly elevated, short, laminar, situated near the anterior extremity of the hinge line just below the line cardinals. Posterior laterals much stronger, remote from and below, the line of the cardinals; PI and PII somewhat tuberculiform; PIII formed by the shell margin. Ligament external, opisthodetic, seated on prominent nymphs. Adductor scars large, situated at the extremities of hinge margin. Anterior adductor scar linguiform, buttressed by a low ridge originating in the umbonal cavity. Posterior adductor scar ovate, less well impressed. Anterior wall of umbonal cavity of each valve with a large deeply impressed pedal muscle scar. Pallial line continued from the anterior adductor scar to the pedal muscle as a row of close-set pits. Pallial sinus broad and shallow. Ornament consisting of fine concentric growth lines and irregularly spaced concentric undulations marking growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype F7848 GSQ	62+	29	57+	15 (1 valve)
Paratype F7836 GSQ	69	32	55	16 (")

Remarks: Onestia wallumbillaensis sp. nov. is closely related to the species described from the Aptian Maryborough Formation by Etheridge Snr (1872, p.339, pl.17, fig.4) as "Genus?" and by Etheridge Jnr (1892, p.569, pl.27, fig.1) as Unicardium? etheridgei. The latter differs in its larger size, apparent lack of anterior lateral teeth, and straighter dorsal margins which cause the lateral teeth to lie in line with the cardinals.

Plaster casts of the types of Onestia onestae (McLearn, 1931), the type species of Onestia, kindly furnished by Dr J.A. Jeletzky of the Geological Survey of Canada, show the dentition of that species is comparable to that of Onestia wallumbillaensis. However, the Canadian form is smaller, more transversely elongated, has both adductor muscle scars buttressed and lacks a pallial sinus.

Onestia augathellaensis sp. nov. from the Albian Allaru Mudstone, is smaller, lacks anterior lateral teeth and has a simple pallial line.

Occurrence:

Minmi Member: ?L149 GSQ; ? SB122.

Doncaster Member: RD122; RD221; GAB1384; GAB2098; GAB2166; SB116; SB117; SB123.

Maree Formation: Several localities reported by Ludbrook (1966).

N.S.W.: "White Cliffs" (Guerich, 1901).

Age: Early? - late Aptian.

Onestia augathellaensis* sp. nov.

Pl.38, figs 9-10

*Named after the Augathella district.

Type: Holotype: CPC9295, an internal and external mould of a right valve. Locality: GAB2049, Allaru Mudstone, lower upper Albian.

Material: The holotype and a few incomplete valves.

Specific diagnosis: Small, orbicular, equilateral Onestia, with gently arched dorsal margins, no anterior lateral teeth and a simple pallial line.

Description: Small (length 25mm). Orbicular. Equivalve; well inflated. Equilateral. Dorsal margins gently arched. Anterior, posterior and ventral margins gently rounded. Umbones broad, moderately elevated. Beaks small, orthogyral, centrally situated. Lunule and escutcheon ill defined. Hinge of right valve with two small, cyclodont cardinal teeth (3a, 3b); 3a trigonal, projecting from the hinge margin in front of the beak; 3b trigonal, distally pointed, situated immediately below the beak. No anterior lateral teeth. Posterior lateral PI prominent, laminar, remote from the cardinals; PIII formed by the shell margin. Ligament features and nymphs not observed.
Wall of umbonal cavity with a large, well impressed pedal muscle scar. Pallial line simple, extended beyond the anterior adductor scar to the pedal muscle scar. Ornament consisting of fine concentric growth lines and occasional concentric undulations marking growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
CPC9295	25	12	10	10 (1 valve)

Remarks: Onestia augathellaensis sp. nov. is smaller and more orbicular than the Aptian species O. wallumbillaensis sp. nov., lacks anterior teeth, and has no pallial sinus.

Onestia etheridgei (Etheridge Jnr, 1892) from the Aptian Maryborough Formation differs in its quadrate shape and larger size.

The type species of Onestia, Onestia onestae (McLearn, 1931) from the Albian Clearwater Formation of Alberta, is similar in size to O. augathellaensis, but is more transversely ovate and has anterior lateral teeth.

Occurrence:

Allaru Mudstone: GAB2049.

Age: Early late Albian.

Superfamily MACTRACEA Lamarck, 1809

Family Mactridae Lamarck, 1809

Remarks: This family comprises equivalve, more or less trigonal shaped shells, which are closed or have a slight posterior gape. The hinge normally has two diverging cardinal teeth in each valve, two anterior and posterior lateral teeth in the right valve, and one anterior and one posterior lateral in the left valve; the anterior cardinal tooth is triangular and may be deeply notched; the posterior cardinal tooth is small and frequently rudimentary. The ligament is partly internal and is accommodated in a chondrophore set behind the cardinal teeth. The pallial sinus is usually small and the ornament is concentric.

Differences in the chondrophore and pallial features allow the recognition of numerous genera and several subfamilies of mactrids. The family is a comparatively modern one, with its oldest representatives known from the Cretaceous. Mactrids are a flourishing group in Recent shallow seas. Some forms are particularly abundant in estuarine habitats.

The inclusion of the genus Barcoona Finlay (1927) (= Pachydomella Etheridge Jnr, 1907, non Ulrich, 1891) in the family

Mactridae is only tentative, as the hinge features are not fully known. Vokes (1967, p.344) who incorrectly listed *Barcoona* as a Palaeozoic genus, did not attempt to classify it.

Genus *Barcoona* Finlay, 1927

Type species (by original designation): *Pachydomella chutus* Etheridge Jnr, 1907, (= *Mactra trigonalis* Moore, 1870), Aptian-Albian, Great Artesian Basin.

Generic diagnosis: Small; thick shelled. Trigonal- ovate; almost equilateral. Well inflated; not gaping. Dorsal margins nearly straight, meeting at the umbo at an angle of about 120°. Ventral margins gently convex. Hinge and ligament features not fully known; "right valve with two cardinal teeth (3a, 3b); anterior lateral teeth, posterior lateral teeth not observed" (*fide* Ludbrook, 1966, p.182). Adductor scars large. Pallial line simple. Ornament consisting of fine, close-set concentric lamellae, with several widely spaced, very prominent depressions marking growth halts.

Range: Aptian - Albian.

Remarks: Finlay (1927, p.526) noted that *Pachydomella* Etheridge Jnr (1907, p.325) was pre-occupied and renamed the genus *Barcoona*. Subsequently, Ludbrook (1966, p.182) united Etheridge Jnr's nominal species *Pachydomella chutus* with *Mactra trigonalis* Moore (1870,p.252), adopting the name *Barcoona trigonalis* (Moore).

Etheridge Jnr (1907, p.325) reported that the species was edentulous. However, Ludbrook (1966, p.182) stated that the right valve has two cardinal and two anterior lateral teeth. However,this dentition is not clearly shown in her illustration (pl.25, fig.6). Attempts to develop the hinges of specimens of Barcoona trigonalis in the present collections have so far been unsuccessful.

Barcoona is an endemic monotypic genus, and in Queensland, ranges from near the top of the upper Aptian Doncaster Member to the lower upper Albian Mackunda Formation.

Barcoona trigonalis (Moore), 1870

Pl.38, figs 14-17

Synonymy:

1870 Mactra trigonalis Moore, p.252, pl.14, fig.6.

1907 Pachydomella chutus Etheridge Jnr, p.325, pl.59; pl.62, figs 4-8.

1927 Barcoona chutus Finlay, p.526.

1966 Barcoona trigonalis (Moore); Ludbrook, p.182, pl.25, figs 6-9.

Types: Mactra trigonalis (Moore). Holotype: Lost. Locality: "Downs on the Nive River", Coreena Member, lower Albian. Neotype: (designated by Ludbrook, 1966, p.182) F10558 AM. Locality: "Sources of the Barcoo, Ward and Nive Rivers, south central Queensland", Coreena Member, lower Albian.

Pachydomella chutus Etheridge Jnr. Lectotype F10558 AM (called the holotype by Ludbrook, 1966, p.182) (slab of specimens figured by Etheridge Jnr, 1907, pl.59). Paralectotypes: F13704 AM (specimen of pl.62, fig.4); F13705 AM (specimen of pl.62, fig.5); F13706 AM (specimen of pl.62, fig.6); F13707 AM (specimen of pl.62, fig.8); F13709 AM (specimen of pl.62, fig.7). Locality: Lectotype and Paralectotypes from "Sources of the Barcoo, Ward, and Nive Rivers, south central Queensland", Coreena Member, lower Albian.

Material: Innumerable specimens, typically occurring as separated valves in coquinas.

Specific diagnosis: Small gregarious *Barcoona*.

Description: Small (length less than 10mm). Gregarious. Equivalve; well inflated; valves closed. Almost equilateral. Trigonal-ovate in shape. Anterior tapering, bluntly rounded. Posterior somewhat obliquely truncate. Dorsal margins nearly straight, sloping, forming an angle of about 120° at the umbo. Ventral margins gently convex. Umbones slightly anterior, rising above the hinge margin. Beaks small, sharp, prosogyral. Hinge and ligament features not observed. Adductor muscle scars large, suboval and subequal, moderately impressed. Pallial line simple. Ornament consisting of fine, close-set, concentric lamellae, with several, widely spaced, very prominent concentric depressions marking growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
F13704 AM	8	4	5	-
F13705 AM	6	3	4	-
F13706 AM	8	3.5	5.5	-
F13707 AM	5	2.5	3	2 (1 valve)
F13709 AM	5+	3	3.5	2 (")
CPC9376	8	3.5	6	3 (")
CPC9502	9	4	7	3 (")

Dimensions: (mm) (Ctd)	Length	Anterior length	Height	Inflation
CPC9845	8	3.5	6	3 (1 valve)
CPC9849	8.5	4	6	2 (")

Remarks: The types of *Mactra trigonalis* Moore (1870) were lost by fire in Sydney in 1882 (Etheridge Jnr, 1892, p.xvi). Ludbrook (1966, p.182) designated F10558 AM as the neotype of this species. She also referred to F10558 AM as the "holotype" of *Pachydomella chutus* Etheridge Jnr. At present this number refers to the slab of specimens figured by Etheridge Jnr (1907, pl.59). One of these should be selected and figured as the neotype of *Mactra trigonalis* Moore and the lectotype of *Pachydomella chutus* Etheridge Jnr. Etheridge's specimens may be considered topotypes of Moore's species.

Barcoona trigonalis (Moore) characteristically forms coquinas in the Coreena Member, but also has a sparse representation in the Doncaster and Ranmoor Members, and the Mackunda Formation of the Manuka area.

Occurrence:

Doncaster Member: GAB2094.

Ranmoor Member: BMR Richmond 1 (80'6"-80'6½").

Coreena Member: "Downs of the Nive River" (Moore, 1870); "Sources of the Barcoo, Ward and Nive Rivers, South Central Queensland" (Etheridge Jnr, 1907); GAB1380; GAB1400; GAB1438; GAB1700; GAB1701; GAB1933; GAB1936; GAB2039; GAB2041; GAB2043; GAB2055; GAB2056; GAB2057; GAB2059; GAB2061; GAB2062; GAB2079; GAB2081; GAB2084; GAB2085; GAB2086; GAB2087; GAB2088; GAB2090; GAB2107; GAB2108; SB101; SB103; SB109; BMR Longreach 5 (104'6"-147'1").

Mackunda Formation: GAB671; GAB673; GAB815?; GAB923?; GAB1106.

Maree Formation: Numerous localities reported by Ludbrook (1966).

Age: Late Aptian - early late Albian.

Superfamily TELLINACEA Blainville, 1824

Family Tellinidae Blainville, 1824

Remarks: Genera included in the Tellinidae have comparatively thin shells, are equivalved or slightly inequivalved, laterally compressed, transversely ovate to ovately trigonal in outline, and have inconspicuous, subcentral to posterior umbones which are sometimes opisthogyral. The hinge usually has one bifid and one blade-like cardinal tooth in each valve as well as anterior and posterior laterals, but the teeth, especially the laterals, are subject to reduction. The ligament is external and opisthodetic, and the pallial sinus is very deep. Exterior ornament is subdued, and consists of fine concentric ribs and growth straie, with or without fine radial ribs and striae.

The Tellinidae are essentially a modern group. The earliest species of the family appeared in the Jurassic. Considerable diversification took place during the Cretaceous and Tertiary (Chavan, 1950).

Genus Palaeomoera Stoliczka, 1870

Type species (by original designation): Tellina strigata Goldfuss 1840, Upper Cretaceous, Germany.

Generic diagnosis: "Shell elongated, hinder part shorter, the upper declivity slightly convex, posterior end sub-truncate, beaks directed forwards, ligament situated on thickened but not prominent fulcra; hinge with one anterior, long, lamelliform tooth in each valve, bifid in the right, single in the left; posterior cardinal tooth not distinctly traceable in either valve; laterals less distinct in the left valve" (Stoliczka, 1870, p.116).

Range: Cretaceous.

Remarks: Stoliczka (1870, p.116) proposed Palaeomoera as a subgenus of Tellina. He remarked that the subgenus resembled the Recent Moera H. & A. Adams (= Moerella Fischer), but could be distinguished by its hinge features. However, Dailey and Popenoe (1966) have noted that the dentition of the genus is difficult to interpret. The hinge of the type species illustrated by Holzapfel (1889, pl.11, figs 9-10) is possibly transposed. Because of this, reference of Palaeomoera milligani sp. nov. to Palaeomoera is very tentative. The lack of lateral teeth and radial ornament may well exclude the form from the genus.

Palaeomoera ? milligani* sp. nov.

Pl.39, figs 14-19

*Named after Mr E.N. Milligan, formerly of the Bureau of Mineral Resources,who collected the paratypes.

Synonymy:

1872 Tellina sp. Etheridge Snr, p.341, pl.20, fig.1.

1892 Palaeomoera ? sp. ind. Etheridge Jnr, p.570, pl.26, fig.17 only.

1961 Gari elliptica Whitehouse; Woods, p.3.

1966 Palaeomoera sp. Ludbrook, p.177, pl.24, fig. 9.

1966 Tatella maranoana Etheridge Jnr; Ludbrook, pl.24, fig.1 only.

1966 Genus indet. sp. nov. Skwarko, p.118, pl.13, figs 4-5.

Types: Holotype: CPC9212, an internal mould of slightly opened valves with portion of the external mould of the right valve. Locality: GAB1942, Minmi Member, lower Aptian. Paratypes: CPC9213 and CPC 9214,internal moulds of slightly opened valves. Locality: SB129, Doncaster Member, upper Aptian.

Material: Six specimens with valves almost closed, and six less complete specimens with widely opened valves.

Specific diagnosis: Medium sized; rather deltoid shaped; almost equilateral; umbones median; dorsal margins sloping, forming an angle of about 140° at the umbo; valves closed; hinge formula $\frac{2a,\ \ 2b}{3a,\ \ 3b}$; no lateral teeth; pallial sinus wide and deep; exterior with fine concentric ribs and growth lines.

Description: Medium sized (length 40-60mm). Shell thin. Transversely elongated and rather deltoid shaped; almost equilateral; laterally compressed. Dorsal margins arched, forming an angle of about 140° at the umbo. Ventral margins gently curved, meeting the antero-dorsal and posterior margins just below mid-height. Valves closed. Posterior truncation oblique. Umbones inconspicuous, situated at mid-length. Lunule and escutcheon very poorly defined. Hinge with 2 cardinal teeth in each valve. Teeth of left valve almost equal in size, 2a orthocline, 2b opisthocline. Teeth of right valve unequally developed, 3a orthocline, 3b opisthocline, much smaller than 3a. No lateral teeth. Ligament external, opisthodetic, seated on short nymphs. Anterior adductor scar wedge shaped, tapering umbonally, very deeply impressed. Posterior adductor scar rounded, attenuated dorsally. Pallial line with a wide, deep sinus extending almost to mid-length; lower margin of pallial sinus confluent with pallial line, forming a linear posterior extension. Exterior ornamented with fine, concentric growth lines and less regularly spaced, weak concentric ribs.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype CPC9212	52	25	32	8 (1 valve)
Paratype CPC9213	53	25	37	8 (")
Paratype CPC9214	55+	21+	35	
CPC9215	59	28	39	10

Remarks: (1) Affinities: *Palaeomoera* ? *milligani* sp. nov. has been confused with *Tatella maranoana* (Etheridge Jnr) and *Laevicanotia elliptica* (Whitehouse). *Palaeomoera* ? *milligani* resembles *Tatella maranoana* in its adductor muscle scars, submedian umbones, and the absence of lateral teeth, but differs from the former in its deltoid shape, cardinal dentition and deep pallial sinus. *Laevicanotia elliptica*, which has similar adductor scars and a deep pallial sinus, is distinguished by its cardinal dentition, anterior umbones, and transversely elliptical shape.

Palaeomoera ? *mariaeburiensis* (Etheridge Snr, p.341, pl.20, figs 6-6a) from Maryborough is somewhat similar, although the umbones are slightly posterior and the dorsal margins are less arched.

(2) Functional Morphology: For reasons outlined in the following section on *Laevicanotia*, the shape and deep pallial sinus of *Palaeomoera* ? *milligani* suggest that the species was adapted to an active, deep burrowing existence. The common occurrence of specimens with closed valves also suggests a deep burrowing habit. The anterior elongation of the shell suggests that the foot was large and probably required an extensive pedal gape. An extensive pedal

gape coupled with the occurrence of long, retractable siphons (indicated by the very deep pallial sinus), would leave little mantle tissue connecting the ventral edges of the shell. In these circumstances, the development of a cruciform muscle like that of living tellinaceans seems likely. However, the available material is not sufficiently well preserved postero-ventrally to detect the presence of cruciform muscle scars.

Owen (1959) has indicated that the development of the foot in living tellinaceans may be correlated with the animals capacity for horizontal movement. This, in turn, is correlated with the feeding habits of the group. Living tellinaceans are mobile deposit feeders which ingest bottom detritus collected by the inhalent siphon (Yonge, 1949). Palaeomoera ? milligani approaches the shape of living tellinids, and in addition, has the musculature and pallial characters of that family. Probably, its life habits were similar. Closed valves of Palaeomoera ? milligani occur both in dark mudstones and fine silty sandstones.

Occurrence:

Minmi Member: GAB1942; SB127.

Doncaster Member: GAB1134; GAB1236; RD222; SB129.

Maryborough Formation:"Maryborough"(Etheridge Snr, 1872)

Blackdown Formation: W3; W8; W10; W34; W35; W47; W50 (Woods, 1961).

Mullaman Beds: TT21 (Skwarko, 1966).

Maree Formation: Maree 5/646/18; Algebuckina 5/571/34; Hamilton 5/520/1 (Ludbrook, 1966).

Age: Early - late Aptian.

Family Icanotidae Casey, 1961

Remarks: This family was proposed by Casey (1961c, p.581) for Cretaceous offshoots from *Tancredia* which retain the simple cardinal dentition of the Tancrediidae but have a deep pallial sinus. Members of the family are possibly forerunners of the Tertiary and Recent Garidae from which they are distinguished by their inequilateral shells and non-bifid cardinal teeth.

Casey included only two genera in the family, *Icanotia* Stoliczka and a new genus *Scittila*, Species of *Icanotia* have been described from the Aptian of England and Switzerland, the Albian of England, the Cenomanian of France and India, the Senonian of Austria, India and Peru, and the Maestrichtian of the United States, but the genus is never common (Casey, 1961c, p.583). Species of *Scittila* are known from the Hauterivian of Switzerland and the Aptian of England (Casey, 1961c, p.584), and the Aritan (upper Neocomian) of Japan (Hayami, 1965b, p.126).

Two more genera *Tancretella* Ludbrook (1966) and *Laevicanotia* gen. nov., are now referred to the family. *Laevicanotia* is closely related to *Icanotia* but lacks radial ornament. *Tancretella* retains the primitive outline and inflation of *Tancredia*, but has the deep pallial sinus typical of icanotid genera.

Genus *Laevicanotia* gen. nov.

Type species: *Gari elliptica* Whitehouse, 1925, Aptian, Great Artesian Basin.

Generic diagnosis: Equivalve. Inequilateral. Elliptical, narrowing anteriorly. Valves gaping slightly posteriorly. Umbones not conspicuous, situated in anterior one-third of shell. Cardinal teeth well developed, supported by a small umbonal thickening. Hinge formula $\frac{3a, 3b}{2}$. No lateral teeth. Ligament external, opisthodetic. Nymphs prominent. Anterior adductor scar wedge-shaped, tapering umbonally, deeply impressed. Posterior adductor scar rounded. Pallial sinus deep. Exterior ornamented with fine concentric ribs and growth lines.

Range: Aptian.

Remarks: (1) Affinities: Whitehouse (1925, p.32) thought "*Gari*" *elliptica* was a typical representative of the genus *Gari* Schumacher. The interpretation of the type species of *Gari* is a controversial matter. Cox (1960b) proposed that the Recent Indian Ocean species *Tellina gari* Linnaeus be recognised as the type of *Gari* and he designated and illustrated a neotype. However, none of the possible type species of *Gari*, nor the type species of its possible synonym *Psammobia* Lamarck (*Tellina fervensis* Gmelin) could be considered congeneric with "*Gari*" *elliptica*. The living species of *Gari* are almost equilateral and there are two bifid cardinal teeth in valve, as well as anterior and posterior laterals. By contrast, "*Gari*" *elliptica* has anterior umbones, no lateral teeth, the cardinals are non-bifid, while there is only a single tooth in the left valve. Only the pallial sinus is essentially similar.

The dentition of *Laevicanotia* corresponds closely to that of

Scittila and Icanotia. The cardinal teeth are the same in number and arrangement, although in Laevicanotia the anterior cardinal in the right valve (3a) tends to be larger than the posterior (3b). In Scittila and Icanotia this arrangement is reversed. All three genera lack lateral teeth.

Several species of Icanotia, notably the Lower Cretaceous ones, are very similar in outline to Laevicanotia elliptica, whereas the Upper Cretaceous ones are more elongate posteriorly and rather soleniform. However, all Icanotia species have prominent radial ribbing which is lacking in Laevicanotia elliptica. The pallial sinus of Icanotia as seen in I. pulchra Wade (1926, pl.29, figs 5-6) is confluent with the pallial line along its ventral margin, but does not extend as far forward as in L. elliptica. Scittila, with its subcentral umbones and carinate posterior, does not appear to be so closely related.

Whitehouse (1925, p.32) thought "Psammobia" atherstoni Sharpe (1856, p.196, pl.22, fig. 11a-c) from the Uitenhage Beds of South Africa might be congeneric with "Gari" elliptica. The shape and anterior umbones are similar but the nature of the dentition and musculature is not readily apparent from Sharpe's description and figures.

In its anterior umbones and anteriorly narrowed elliptical shape Laevicanotia presents a remarkable homeomorphic resemblance to species of the venerid genus Legumen Conrad (1858). According to Stephenson (1923, p.319) Legumen is a senior subjective synonym of *Baroda* Stoliczka, and it is interesting to note that *Icanotia* was proposed by Stoliczka (1870) as a subgenus of *Baroda*.

(2) *Functional morphology*: From the work of Yonge (1949) and Owen (1959) it is evident that within the Tellinacea, and probably in other groups as well, there is a close correlation between shell morphology and the living position and feeding habits of the animal. Living tellinacean genera burrow deeply for protection, while actively moving through the bottom deposits on which they feed (Yonge, 1949; Owen, 1959; Holme, 1961). Adaption to this mobile, deposit feeding, deep burrowing existence has produced laterally compressed, elongate-ovate shells. Development of a large active foot is marked by elongation of the shell in front of the umbones, so the anterior is frequently longer than the posterior. Accommodation of long, retractable siphons necessitates a deep embayment in the posterior part of the mantle cavity. This is reflected in the depth of the pallial sinus and the generally poor development of a siphonal gape.

Tellinacean genera may be contrasted with the deeply burrowing, sessile filter feeders of the Laternulidae, which are strongly inflated, not markedly elongated anteriorly, and although possessing a wide pallial sinus, have a wide siphonal gape, as the siphons are only partly retractable.

The elongate compressed form, deep pallial sinus, and small siphonal gape of *Laevicanotia elliptica* suggest that this species was adapted to a mobile, deep burrowing existence, similar to that of living tellinacean species. Specimens of *L. elliptica* are commonly found with closed valves and this supports the interpretation.

The anterior end of Laevicanotia is noticeably shorter than the posterior. Perhaps this indicates that the foot was not as large an organ as it is in living genera such as Tellina and Gari. No pedal muscle scars have been observed on specimens of L. elliptica. However, in living tellinacean genera the pedal muscles are inserted alongside the adductor muscles (Graham, 1934). If Laevicanotia possessed similar pedal musculature it is doubtful whether the small pedal muscle scars would be distinguished from the adjoining, much larger, adductor muscle scars.

In Laevicanotia the pallial line between the anterior adductor and the anterior termination of the pallial sinus is quite short in length. As the mantle must be open along part of this distance for protrusion of the foot, it follows that there is scarcely any tissue connecting the ventral edges of the shell. In addition there is very little space to attach the siphonal muscles responsible for the extrusion and withdrawal of the siphons.

This problem arises in living tellinaceans and is resolved in two different ways. In certain genera, an accessory muscle, the cruciform muscle, is developed (Graham, 1934) (Yonge, 1949). This serves to tie the ventral edges of the valves together and to take the strain during extrusion and withdrawal of the siphons. It also functions as a proprioceptor or sensory device. The cruciform muscle leaves two small scars below the linear posterior extension of the pallial line, and may cause an inward curvature of the ventral margin. No cruciform muscle scars have been detected on the available specimens of *Laevicanotia elliptica*, but these are not well preserved.

An alternative solution to this functional problem occurs in the Novaculinidae (Yonge,1949). In this group of vertical burrowers the foot is protruded very anteriorly and there is a large area of ventral mantle fusion. The latter is increased by incomplete withdrawal of the siphons in this group. The slight posterior gape of *Laevicanotia elliptica* suggests that the siphons may not have withdrawn fully. This in turn suggests that the solution utilized may have involved fusion of the ventral parts of the mantle rather than development of a cruciform muscle.

A few deductions concerning the nature of the ligament may also be made. In all bivalves the ligament comprises a superficial periostracum, an outer and an inner ligament layer which are analogous to the periostracum, outer and inner calcareous layers of the shell (Owen, *et al.*, 1953). This primary ligament is usually extended secondarily, either by periostracum or by fusion layer. The different tissues result from secretion by differently fused mantle folds. The extent of pallial muscle, as indicated by the development of pallial line dorsally, may be used to determine the type of fusion of the mantle folds responsible for secretion of the ligament. This in turn, distinguishes the type of secondary extension of the primary ligament (Owen, 1958). The pallial line in *Laevicanotia elliptica* extends above the anterior and posterior adductors towards the umbonal cavity. This probably indicates that secondary extension of the ligament is mainly by periostracum, and that fusion layer, if developed, is not extensive.

Laevicanotia elliptica (Whitehouse), 1925

Pl.39, figs 8-13; text fig.15C

Synonymy:

1901 Tatella maranoana Etheridge Jnr, pl.2, fig.8 only.

1902a Tatella maranoana Etheridge Jnr, pl.2, fig.25 only.

1925 Gari elliptica Whitehouse, p.32, pl.1, figs 7-8.

1966 Tatella aptiana Whitehouse; Ludbrook, pl.24, fig.5 only.

1966 Tatella elliptica (Whitehouse); Ludbrook, p.178 (pars.).

Type: Holotype: T1284 AUGD. Locality: "Lake Eyre Basin", Maree Formation, Aptian.

Material: Six internal moulds with closed valves, some of which retain shelly material; one internal mould of a right valve and one internal mould of a left valve.

Specific diagnosis: Elliptical shaped Laevicanotia with very weakly arched dorsal margins; valves slightly gaping posteriorly.

Description: Thick shelled. Elliptical shaped, anterior narrower than posterior; length about 1.8 times height. Moderately inflated, maximum inflation and height developed near the posterior truncation of the nymph. Inequilateral. Dorsal margins weakly arched. Anterior and ventral margins gently rounded, meeting in an even curve. Posterior expanded, very obliquely truncated, gaping slightly. Umbones broad,not conspicuous, situated in the anterior one-third of the shell. Lunule and escutcheon not developed. Hinge plate supported by a small umbonal thickening. Left valve with a single conical tooth (2); right valve with two cardinal teeth (3a and 3b); 3a orthocline, larger than 3b; 3b opisthocline. Lateral teeth absent. Ligament opisthodetic, external, seated on a long prominent nymph, occupying most of the postero-dorsal margin. Anterior adductor scar wedge-shaped, tapering umbonally, very deeply impressed. Posterior adductor scar bulbous in shape, attenuated dorsally. Pallial line continued above the adductor scars. Pallial sinus wide and deep, extending to the line of the umbones; lower margin of pallial sinus confluent with the pallial line, forming a linear posterior extension. Exterior ornamented with fine concentric growth lines, and less regularly spaced, weak concentric ribs.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Holotype	T1284 AUGD	48	16	25	7 (1 valve)
	F7855 GSQ	50	17	25	22
	F3165 GSQ	45	15	22	19
	F7853 GSQ	40	14	20	-

Remarks: *Laevicanotia elliptica* (Whitehouse) has been confused with both *Tatella maranoana* (Etheridge Jnr) and *T. aptiana* Whitehouse. The holotype of *L. elliptica* (T1284 AUGD) is an umbonally damaged right valve which shows only exterior features. It was originally illustrated by Etheridge Jnr (1901, pl.2, fig.8) as *Tatella maranoana*. At the time the sole locality cited for that species was

"Maranoa River half-a-mile above Mitchell Railway Station". Etheridge Jnr (1902a) refigured the specimen and gave its correct locality, "Lake Eyre Basin".

Whitehouse (1925) designated the specimen of the earlier figure the holotype of *Gari elliptica*. He did not realize that Etheridge had illustrated the same specimen twice. Topotypic material figured by Whitehouse (1925, pl.1, figs 7-8) revealed the interior features including the deep pallial sinus.

Ludbrook (1966) regarded Whitehouse's specimens of "*Gari*" *elliptica* as typical representatives of *Tatella maranoana*, but retained the species "*Gari*" *elliptica* based on Etheridge's specimen and transferred it to *Tatella*. However, specimens illustrated by Ludbrook (1966, pl.24, figs 3-4, 6-7) as "*Tatella*" *elliptica* are misidentified. Only GSSA M1617 figured by Ludbrook (1966, pl.24, fig.5) as *Tatella aptiana* Whitehouse, is conspecific with *Laevicanotia elliptica*.

The dentition and adductor muscle scars of *Tatella maranoana* and *T. aptiana* resemble those features of *Laevicanotia elliptica*, and there is a superficial resemblance in shape. However, *L. elliptica* is clearly distinguished by its anterior umbones and very deep pallial sinus. *Tatella* has submedian umbones and a shallow pallial sinus.

Although *Laevicanotia elliptica* is sometimes found in association with *Tatella maranoana* in dark muddy sediments, evidence from functional morphology suggests that the two occupied different ecological niches.

Palaeomoera ? milligani sp. nov. has a deep pallial sinus and adductor muscle scars like Laevicanotia elliptica. The former may be distinguished by its submedian umbones, "tellinid" cardinal teeth and deltoid shape.

Occurrence:

Doncaster Member: RD221; RD222; L98 GSQ; L99 GSQ; GAB2152; SB116?

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a); Algebuckina 5/571/33 (Ludbrook, 1966).

Age: Late Aptian.

Genus Tancretella Ludbrook, 1966

Type species (by original designation) : Myacites planus Moore, 1870 Aptian, Great Artesian Basin.

Generic diagnosis: Medium to large in size. Equivalve. Inequilateral. Transversely ovate to ovately trigonal. Well inflated. Umbones prominent, anterior. Hinge formula $\frac{\text{AI-AIII} \quad 3a \quad 3b \quad \text{PI-PIII}}{\text{AII} \qquad 2 \qquad \text{PII}}$; anterior laterals poorly developed, sometimes absent; cardinal teeth 3a and 2 large, bluntly trigonal and upturned distally; 3b reduced. Ligament external, opisthodetic. Nymphs prominent. Anterior adductor scar asymmetrically triangular, deeply impressed, bounded posteriorly by a low buttress. Posterior adductor scar ovate. Pallial sinus wide and deep. Ornament concentric.

Range: Neocomian - Albian.

Remarks: Topotypic material described below fully reveals the hinge of the type species for the first time. Ludbrook's (1966) generic diagnosis is amended herein to accommodate the new information.

Tancretella was referred to the Tellinidae by Ludbrook, but the genus is more appropriately included in the Icanotidae (Day, 1967b, p.13). Tancretella retains the primitive outline, inflation, and the lateral teeth of Tancredia but possesses the deep pallial sinus of icanotid genera.

Tancretella is at present an endemic genus. It is represented in Australia by one Albian species, T. secunda Ludbrook, an Aptian species, T. plana (Moore), and by an unnamed species of Neocomian age.

Tancretella plana (Moore), 1870

Pl.41, figs 6-10

Synonymy:

1870 Myacites planus Moore, p.254, pl.12, fig.10.

1870 Tancredia plana Moore, p.254, pl.13, fig.3.

1892 Macrocallista plana (Moore); Etheridge Jnr, p.476, pl.27, figs 6-8.

1892 ?Cyprina clarkei (Moore); Etheridge Jnr, pl.27, fig.10 only.

1902a Macrocallista? plana (Moore); Etheridge Jnr, p.35, pl.5, figs 7-9.

1902b Macrocallista? plana (Moore); Etheridge Jnr, p.37, pl.5, figs 8-9.

1927 Macrocallista? plana (Moore); Whitehouse, p.145.

1961 Macrocallista plana (Moore); Woods, p.6.

1964 'Myacites' planus Moore; Day, p.18, table 3.

1965 'Myacites' planus Moore; Day, p.418.

1966 Tancretella plana (Moore); Ludbrook, p.179, pl.24, figs 8, 10-12.

?1966 ?"Macrocallista" plana (Moore); Skwarko, p.113, pl.11, figs 14-15.

1967 Tancredia plana (Moore) Skwarko, p.20, pl.3, figs 1, 4-7.

1967b Tancretella plana (Moore); Day, p.13, pl.2, figs 1-4.

Types: Myacites planus Moore. Holotype: Lost. Locality:"Wollumbilla", Doncaster Member, upper Aptian. Neotype: (herein designated) F6042 GSQ, a specimen with closed, slightly displaced valves. Locality: RD122, Doncaster Member, upper Aptian.

Tancredia plana Moore. Holotype: Lost. Locality: "Blythesdale, fifteen miles from Wollumbilla", Minmi Member, lower Aptian.

Material: About 50 internal and external moulds of separated valves and some closed valves.

Specific diagnosis: Comparatively large, thick shelled, transversely ovate Tancretella with gently sloping dorsal margins.

Description: Comparatively large (length 40-90mm). Thick shelled. Inequilateral. Equivalve. Transversely elongated. Length about 1.5 times height. Valves well inflated, closed. Dorsal margins almost straight, sloping more steeply anteriorly than posteriorly. Anterior bluntly pointed. Posterior broadly rounded. Ventral margins gently convex. Umbones broad, prominent, situated in the anterior one-third of shell. Beaks prosogyral, close to the hinge line. Lunule wide, well defined. Escutcheon narrow, deeply impressed. Hinge plate rather narrow, deflected ventrally in each valve by a prominent cardinal tooth. Hinge formula $\frac{\text{AI-AIII} \quad \text{3a} \quad \text{3b} \quad \text{PI-PIII}}{\text{AII} \qquad\quad \text{2} \qquad\quad \text{PII}}$. Anterior lateral teeth poorly developed; AI and AII low and broad; AIII formed by the shell margin. Posterior laterals better developed; PI and PII narrow and elevated; PIII formed by the shell margin. Left valve cardinal tooth (2) large, bluntly trigonal and upturned distally, situated immediately behind the umbo. Right valve cardinal tooth (3a) orthocline, situated immediately below the umbo, similar in size and shape to the cardinal tooth (2). Right valve cardinal tooth (3b) very much reduced, markedly opisthocline. Ligament external, opisthodetic, seated on well developed, short nymphs. Adductor muscle scars large and dorsally situated. Anterior adductor scar asymmetrically triangular, deeply impressed, bounded posteriorly by a low ridge or buttress. Posterior adductor scar ovate, not deeply impressed. Anterior pedal muscle scar a comparatively large, deep, triangular pit situated immediately above and behind the anterior adductor scar. Pallial sinus very wide and very deep, extending to mid-length. Exterior ornamented with shallow, irregularly spaced depressions marking growth halts, and fine concentric growth lines.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Neotype	F6042 GSQ	72	24	48	35
Topotype	F6049 GSQ	60+	21+	42	14 (1 valve)
"	F35500 UQ	88	31	57	20 (")
	F35531 UQ	60+	21	38	15 (")
	F1332 GSQ	57	21	35+	12 (")
	F7897 GSQ	69	23	48	15 (")
	CPC9899	72	25	50	14 (")

Remarks: Moore's type, which was poorly figured, was lost in the Garden Palace fire in Sydney in 1882 (Etheridge Jnr 1892, p.xvi). The neotype (F6042 GSQ) now selected from topotypic material is a partially exfoliated specimen with closed, slightly displaced valves. Other topotypes (notably F35500 UQ) clearly show the hinge features.

The present interpretation of this species corresponds closely to that of Etheridge Jnr (1892; 1902a, b). However, specimens described from "Gordon Downs" by Etheridge Snr (1872, p.348) as Myacites? sp. (pl. 25, fig.7) and Tancredia sp? (pl.25, fig.8), and which were subsequently placed in synonymy with Moore's species by Etheridge Jnr (1902a, b) are not considered conspecific with Tancretella plana. The specimens in question are from Gordon Downs near Clermont, a Permian locality (J.T. Woods pers. comm.). However, Etheridge Jnr's treatment of Tancredia plana Moore (1870, p.254, pl.13, fig.3) from "Blythesdale, fifteen miles from Wollumbilla" as a synonym, is accepted.

Skwarko (1967, p.20) referred Tancretella plana to the genus Tancredia Lycett, but the deep pallial sinus of T. plana precludes such reference.

Tancretella plana (Moore) may be confused with small specimens of Fissilunula clarkei (Moore). However, the latter is less elongate, the pallial sinus is shallow not deep, and the dentition is quite distinct.

Occurrence:

Minmi Member: "Blythesdale, fifteen miles from Wollumbilla" (Moore, 1870); "Minmi near Roma" (Etheridge Jnr, 1892); "Red Hill"; "por. 13, par. Euthulla"; "R199, par. Euthulla" (Whitehouse, 1927); RD82; RD94; RD97; RD109; RD119; RD128; RD283; RD285; L101 GSQ; L139 GSQ; L141 GSQ; L143 GSQ; L149 GSQ; L150 GSQ; L153 GSQ; L269 GSQ; L270 GSQ; L272 GSQ; L2162 UQ; SB107; SB203; SB207; SB226; SB227; SB228; SB231; SB232; SB264.

Doncaster Member: "Wollumbilla" (Moore, 1870); RD117; RD122; GAB870; GAB1115; GAB1145; GAB1831; GAB2098; SB106.

Blackdown Formation: "Walsh River" (Etheridge Jnr, 1892); W8; W10; W35; W50 (Woods, 1961).

Mullaman Beds: TT20? (Skwarko, 1966).

Maree Formation: "L. Eyre Basin" and "Beresford Spring" (Etheridge Jnr, 1902a) and numerous additional localities reported by Ludbrook (1966).

N.S.W.: "Waratta Creek near Mt Poole" (Etheridge Jnr, 1902b).

W. Aust.: "Gibson Desert, localities Be7 and 40" (Skwarko, 1967).

Age: Early - late Aptian.

Tancretella secunda Ludbrook, 1966

Pl.41, figs 1-3

Synonymy:

1902a *Tellina* sp. ind. Etheridge Jnr, pl.4, fig.15.

1966 *Tancretella secunda* Ludbrook, p.180, pl.24, figs 13-15.

Types: Holotype: GSSA M1590. Locality: Algebuckina 5/571/17, Bulldog Shale, Albian. Paratypes: GSSA M1589 and M1661. Locality: Toodina 5/570/6, Bulldog Shale, Albian.

<u>Material</u>: About 100 internal and external moulds of closed as well as separated valves.

<u>Specific diagnosis</u>: Small to medium sized, thin shelled, very transversely elongated <u>Tancretella</u>, with a slightly sloping antero-dorsal margin.

<u>Description</u>: Thin shelled. Small to medium sized (length 20-60mm). Inequilateral. Equivalve. Transversely ovate. Length almost twice height in larger specimens. Valves well inflated, closed. Antero-dorsal margin straight, slightly sloping. Postero-dorsal margin gently arched. Anterior bluntly pointed. Posterior broadly rounded. Ventral margins gently convex. Umbones prominent, situated about one-third of shell length from anterior. Beaks prosogyral, close to the hinge line. Lunule wide. Escutcheon narrow. Hinge without anterior lateral teeth. Left valve cardinal tooth (2) well developed, conical, situated just behind the umbo. Right valve cardinal tooth (3a) similar in size and appearance, situated immediately below the umbo. Right valve cardinal tooth (3b) apparently not developed. Postero-lateral teeth PI and PIII long and narrow; PIII formed by the shell margin. Ligament external, opisthodetic, seated on short nymphs. Anterior adductor muscle scar somewhat triangular, not deeply impressed. Posterior adductor scar ovate. Pallial line with a wide, deep sinus extending almost to mid-length of shell. Exterior ornamented with fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype M1590 GSSA	45	16	23	-
Paratype M1589a GSSA	55	-	28	-
" M1589b GSSA	60	-	34	-
" M1661 GSSA	34	11	19	13
CPC9293	20	7	13	5 (1 valve)
CPC9344	28+	10	17	8 (")
CPC9292	42+	13	28	20
CPC9360	38	13	21	10 (")

Remarks: *Tancretella secunda* Ludbrook may be distinguished from the Aptian species *T. plana* (Moore) by the former's usually smaller size, thinner shell, greater transverse elongation and lack of anterior lateral teeth. The species is very common in silty sandstones of the Coreena Member and Mackunda Formation.

Occurrence:

Coreena Member: GAB1703; GAB1936; GAB2059; GAB2085; GAB2087; GAB2090?; GAB2107; GAB2108; SB103.

Allaru Mudstone: GAB786?

Mackunda Formation: GAB849; GAB908; GAB1250; GAB1301?; GAB1309; GAB1311; GAB1312; GAB1318; GAB1331?; GAB1336; GAB1360; GAB1368?; GAB2071; GAB2103; GAB2110; Ju3.

Maree Formation: "L. Eyre Basin" (Etheridge Jnr, 1902a); Nilpinna 5/501/2 (Ludbrook, 1966).

Bulldog Shale: Algebuckina 5/571/17; Toodina 5/570/6 (Ludbrook, 1966).

Age: Early - early late Albian.

Tancretella sp.

Pl.41, figs 4-5

Material: An external mould of a right valve, an internal mould of the umbonal portion of a right valve, and a few fragments of large internal moulds.

Description: Comparatively large (length *c.*60mm). Ovately trigonal in shape. Inequilateral. Moderately inflated. Antero-dorsal margin straight, sloping steeply. Postero-dorsal margin gently arched. Anterior somewhat pointed. Posterior broadly rounded. Ventral margins gently convex. Umbones broad, prominent; situated in the anterior one-third of the shell. Hinge immediately below the umbo of the right valve with a large, conical tooth (3a) and a deep triangular socket behind. Pallial characters and musculature unknown. Ornament consisting of closely spaced, fine concentric ridges and fine concentric growth lines.

Dimensions:	Length	Anterior length	Height	Inflation
CPC9291	58	18	45	10 (1 valve)

Remarks: This form is probably a distinct species, but in view of the limited material available, it is not formally named.

"*Macrocallista*" sp. nov. reported by Woods (1963a) from the "crossing of Normanby River, 1.3 miles north-west of Lakefield homestead" (Battle Camp Formation, Laura Basin), is very similar in outline and may be conspecific. "*Macrocallista*" sp. nov. occurs in association with the Neocomian ammonite *Hatchericeras lakefieldense* Woods (1962a).

Occurrence:

Nullawurt Member: SB221.

Age: Neocomian.

Family Tancrediidae Meek, 1864

Remarks: This family includes equivalve, astartiform, corbuliform, donaciform, transversely ovate, and oblong anteriorly rostrate shells, which may be closed or gaping. A lunule may be present or absent and the ligament is external, opisthodetic and is seated on prominent or inconspicuous nymphs. The dentition is lucinoid, each valve usually with two cardinal teeth, the left posterior and the right anterior subject to reduction. Lateral teeth may be present or absent. The pallial sinus is shallow or not developed, the adductor scars are small and dorsally situated, and the ornament is concentric.

The Tancrediidae seem to comprise relatively undifferentiated stocks which display affinities to a number of families. Cox (1929) and Saul & Popenoe (1962) have remarked upon the difficulties involved in satisfactorily classifying this family and its component genera. The Tancrediidae have been variously included in the Cardiacea (Meek, 1865), Lucinacea (Eberzun, 1960), Tellinacea (Chavan, 1950) and Donacacea (Vokes, 1967). Dechaseaux (1952) included this family, the Trigoniidae, Desertellidae, Unionidae and Megalodontidae in an order Preheterodonta. Equally divergent opinions have been expressed concerning the component genera of the Tancrediidae.

The Tancrediidae possess a lucinoid dentition. However, Recent representatives of the Lucinacea are broadly rounded, and slightly expanded anteriorly, with very large, ventrally elongated anterior adductor scars. In living lucinaceans, the anterior shape and muscle pattern are correlated with the animals unique mode of life. Unlike most burrowing suspension feeders, the inhalent current in modern lucinaceans enters anteriorly through a tube constructed by the foot (Allen, 1958). The enlarged surface of the anterior adductor muscle is ciliated and acts as a sorting area for food particles. Kauffman (1967) demonstrated that this was the mode of life adopted by Cretaceous lucinaceans, and McAlester (1965) claimed its development in Ordovician forms. Thus the musculature and anterior shape of tancrediids are too unlike those of lucinaceans to warrant the inclusion of the Tancrediidae in the Lucinacea.

Saul and Popenoe (1962) stressed the cardiid affinities of the Tancrediidae. They cited forms such as Meekia which have cardiid cyclodont cardinal teeth, and noted that Hemidonax, a genus included in the Tancrediidae by Fischer (1887) and Dall (1895) on shell morphology, has an anatomical structure that places it in Cardiidae (Allen, 1950). Furthermore, in its concentric ornament, smooth ventral margins and poorly developed anterior lateral teeth, the aberrant cardiacean family Lahilliidae approaches the Tancrediidae. However, the relationships between the Tancrediidae and the Cardiacea are not sufficiently close to justify classification of the former within the latter.

Cox (1929) drew attention to the similarity of the hinge features of the Tancrediidae to those of the Donacidae, regarding

Eodonax as a connecting link. The anteriorly elongated donaciform shape of many tancrediids also suggests relationship with the Donacidae. The Tancrediidae are therefore considered to be most closely related to the Donacidae, the major difference between the two families being the weak development or absence of the pallial sinus in the former. The Donacidae are usually included in the Tellinacea, although Vokes (1967) assigned the group superfamily rank.

Casey (1961c) thought the Tancrediidae gave rise to the Cretaceous tellinacean family Icanotidae, which was in turn, the forerunner of the Tertiary-Recent family Garidae.

The genera now referred to the family Tancrediidae are:- Tancredia Lycett, its subgenera Corburella Lycett, Isotancredia Chavan, Palaeomya Zittel and Goubert and Paratancredia Chavan, Corbicellopsis Cox, Eodonax Cox, Maranoana Day, Meekia Gabb and its subgenus Mygallia Saul and Popenoe, Protodonax Vokes, Sakawanella Ichikawa and Tatella Etheridge Jnr.

The oldest species of Tancrediidae occur in the Upper Triassic of Europe and Asia and include representatives of the astartiform Paratancredia and the transversely ovate Sakawanella. Maximum development of the family occurred in the Jurassic. Then, in addition to the astartiform Paratancredia and transversely ovate forms such as Isotancredia and Corbicellopsis, the family was represented by the corbuliform Corburella as well as the markedly inequilateral donaciform Eodonax and the more equilateral donaciform

Tancredia *s.s.* During the Cretaceous the family declined. Most Cretaceous species of *Tancredia* are referrable to *Corburella*. Transversely ovate forms are represented by some early Cretaceous species of *Isotancredia*, *Corbicellopsis* and *Tatella*, while the donaciform type is represented by the European and North American genus *Protodonax*. In addition, a peculiar tancrediid with a rostrate anterior and rather oblong shape appears in the Cretaceous and is represented in Australia by *Maranoana* and in North America by *Meekia* and *Mygallia*. At the close of the Maestrichtian the family became extinct.

Genus *Tancredia* Lycett, 1850

Type species (by subsequent designation Morris and Lycett, 1855, p.91): *Tancredia* *donaciformis* Lycett, 1850, Middle Jurassic, England.

Generic diagnosis: Small to medium sized. Astartiform, donaciform or corbuliform in shape. Anterior tapering and usually acutely pointed. Posterior obliquely truncate, frequently gaping. Umbones subcentral or markedly posterior. Hinge formula $\frac{\text{(AIII) 3a 3b PI (PII)}}{\text{(AII) (AIV) 2 (4b) (PII)}}$. Cardinal tooth 4b, anterior lateral teeth, and some posterior lateral teeth subject to reduction. Posterior lateral teeth well separated from the cardinal teeth. Nymphs short, not prominent. Adductor muscle scars small, orbicular, subequal, situated very close to the hinge margin. Pallial line remote from the margins, usually not definitely sinuate, but occasionally with a wide shallow sinus. Ornament consisting of fine concentric ribs and growth lines.

Range: Triassic - Cretaceous.

Remarks: Cox (1929) informally recognised several well defined groups within the genus Tancredia. Subsequently Chavan (1950) assigned subgeneric names to these groups.

The oldest species of Tancredia s.l. are of late Triassic age. The genus reached its acme in the Jurassic, declined during the Cretaceous and was extinct by the close of the Maestrichtian.

Subgenus Corburella Lycett, 1850

Type species (by monotypy): Corbula curtansata Phillips, 1829, Corallian, England.

Subgeneric diagnosis: Medium sized, subequilateral, corbuliform shaped Tancredia; hinge formula $\frac{(AIII)\quad(3a)\quad 3b\quad PI}{(AII)\quad(AIV)\quad 2\quad(4b)\quad PII}$.

Range: Jurassic - Cretaceous.

Remarks: Cox (1929) recognised a corbuliform group of Tancredia, and suggested that the name Corburella Lycett, based on a misinterpretation of Corbula curtansata Phillips, might be retained for the group. This suggestion was adopted by Chavan (1950).

Most of the Cretaceous species of Tancredia are corbuliform types referrable to this subgenus. An exception is Tancredia schwarzi Kitchin (1913, p.139, pl.7, figs 9-10) from the Neocomian of South Africa, which probably belongs to the subgenus Isotancredia.

Tancredia (Corburella) trigoniformis Day

Synonymy:

1964 Tancredia sp. nov. Day, p.14.

1964 Tancredia sp. Day, table 3.

1967b Tancredia (Corburella) trigoniformis Day, p.11, pl.1, figs 15-21.

Types: Holotype: F35581 UQ, an internal mould of a specimen with opened and slightly separated valves. Paratypes: F35562 UQ, an external mould of a right valve; F35564 UQ and F35578 UQ, internal moulds of right valves; F35576 UQ, an internal mould of a left valve.

Locality: Holotype and Paratypes F35576 UQ and F35578 UQ, RD128; Paratypes F35562 UQ and F35564 UQ, RD99. All specimens from Minmi Member, lower Aptian.

Material: About 30 specimens, mostly preserved as internal moulds.

Specific diagnosis: Medium sized weakly inflated Corburella; cardinal teeth well developed, 3a prominent, 4b absent.

Description: Medium-sized (length 25-40mm). Equivalve. Weakly inflated. Trigonal shaped, produced and somewhat pointed anteriorly. Antero-dorsal margin straight, its junction with the ventral margin occurring at about mid-height. Other margins convex. Umbones slightly posterior. Beaks prosogyral. Lunule well defined. Cardinal teeth borne on a distinct hinge plate; two in the right valve, one in the left. Left valve cardinal tooth (2) conical, pointed distally and projecting well above the hinge plate. Right valve cardinal teeth strong; 3b trigonal, opisthocline, placed immediately below the umbo; 3a prosocline, situated on the antero-dorsal margin and projecting beyond the plane of 3b. Anterior lateral teeth absent. Posterior lateral teeth remote from the cardinals. Left valve with an obscure, laminar lateral (PII) received between a moderately well developed PI and the shell margin that forms PIII. Ligament external, seated on a short nymph. Adductor scars dorsal, faint, small, ovate and subequal. Pallial line obscured posteriorly. Ornament consisting of fine concentric growth lines and shallow concentric grooves about 1mm apart near the centre of the ventral margin.

Dimensions:	Length	Anterior length	Height	Inflation
Holotype F35581 UQ	35	18	26	6 (1 valve)
Paratype F35562 UQ	40+	20	32	9 (")
Paratype F35564 UQ	36	18	28	10 (")
Paratype F35576 UQ	34+	-	27+	6 (")
Paratype F35578 UQ	26+	-	21	6 (")

Remarks: Tancredia (Corburella) trigoniformis closely resembles the neotype of the Jurassic type species of Corburella, Tancredia curtansata, figured by Arkell (1934a, pl.38, fig.9) but lacks the antero-ventral sinuation and wing-like extension of the postero-dorsal margin. As far as can be ascertained from Arkell's figure the hinges of the left valves are similar.

Tancredia subcurtansata Lycett (1863, p.120) (figured by Morris and Lycett, 1855, pl.13, fig.7) from the Great Oolite of England is also similar, but is more acutely pointed anteriorly, and has a much weaker 3a tooth.

Tancredia (Corburella) trigoniformis Day is not unlike a specimen from the Albian of Western Canada figured by McLearn (1919, pl.5, fig.6) as Tellina dowlingi. Subsequently McLearn (1945, pl.3, fig.11) refigured this specimen under the name Tancredia ? dowlingi var. silentia n. var. However, closer comparison is not possible as the hinge of the Canadian specimen is not illustrated, and the pallial characters of the Minmi specimens are unknown. Another specimen figured by McLearn (1919, pl.5, fig.5) as Tellina dowlingi and refigured (1945, pl.3, fig.10) as Tancredia ? dowlingi, was named Tancredia pacia sp. nov. by McLearn (1948). This form is more elongate than the Minmi species.

The holotype of Tancredia stelcki McLearn (1945, pl.10, fig.5) from the Albian of Western Canada is also similar, but unfortunately the hinge is not figured. Specimens of T. stelcki figured by Imlay (1961, pl.4, figs 8-12) from the Albian of Alaska are less similar, and again no hinges are figured.

Occurrence:

Minmi Member: RD78; RD99; RD128; RD205; RD285?; L150 GSQ?; L153 GSQ; L270 GSQ; L271 GSQ; L272 GSQ; SB231.

Age: Early Aptian.

Tancredia (Corburella) aff. trigoniformis Day

Pl.38, figs 1-4

Material: Seven specimens with separated valves, mostly occurring as internal moulds.

Description: Small to medium sized (length 20-35mm). Equivalve. Well inflated. Corbuliform shaped. Anterior end produced and acutely pointed. Antero-dorsal margin straight, its junction with the ventral margin occurring at about mid-height. Other margins convex. Umbones slightly posterior. Beaks prosogyral. Lunule well defined. Hinge with two cardinal teeth in each valve. Left valve with a conical, distally pointed, orthocline, cardinal tooth (2), and a laminar, opisthocline cardinal tooth (4b). Right valve with a prosocline cardinal tooth (3a) situated on the antero-dorsal margin and projecting beyond the plane of the opisthocline, posterior cardinal tooth (3b). Posterior lateral teeth obscure. No anterior lateral teeth. Adductor muscles small, subequal and suboval, situated just below the hinge margin.Pallial features not observed. Ornament consisting of fine concentric growth lines and shallow concentric depressions.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
CPC9334	23	14	14+	8 (1 valve)
CPC9335	33+	-	30	10 (")
CPC9336	24	13	19	8 (")
CPC9337	22	12	17	8 (")

Remarks: This form, which occurs at one locality at the top of the Doncaster Member in the Tambo-Augathella area, closely resembles the Minmi species *Tancredia* (*Corburella*) *trigoniformis* Day in outline. However, the latter is less inflated and has no 4b cardinal tooth.

The Doncaster form is probably a distinct species, but the proposal of a formal specific name is deferred pending clarification of its relationship with "*Corbula*" *superconcha* Etheridge Jnr (1907). The latter occurs in the immediately overlying Coreena Member and is very similar externally, while the hinge features are at present unknown. If "*Corbula*" *superconcha* is shown to have a tancrediid hinge, the two species may be considered conspecific.

Occurrence:

Doncaster Member: GAB2101.

Age: Late Aptian.

Genus *Corbicellopsis* Cox, 1929

Type species (by original designation): *Corbis laevis* J. de C. Sowerby, 1827, Corallian, England.

Generic diagnosis: Medium sized. Transversely ovate, with the anterior end the narrower. Anterior not tapering to an acute extremity. Equilateral or slightly inequilateral, with the posterior end the larger. Equivalve. Moderately or weakly inflated. Valves closed. Umbones depressed, contiguous. No lunule or escutcheon. Hinge formula $\frac{(3a) \quad 3b \quad PI\text{-}PIII}{2 \quad (4b) \quad PII}$. Right anterior cardinal tooth (3a) and left posterior cardinal tooth (4b) small, subject to reduction. Right posterior cardinal (3b) and left anterior cardinal (2) prominent, triangular. Anterior laterals absent. Posterior laterals remote from the cardinals; PI and PII laminar; PIII formed by the shell margin. Ligament external, opisthodetic, seated on prominent nymphs. Adductor muscle scars small, orbicular or ovate; situated close to the hinge margin. Pallial line remote from the margins, simple, or with a rudimentary sinus. Ornament consisting of concentric growth lamellae.

Range: Jurassic - Neocomian.

Remarks: Cox (1929, p.577) observed that *Corbis (Corbicella) bathonica* Morris and Lycett, the type species of *Corbicella* Morris and Lycett (1854) by subsequent designation (Stoliczka, 1870, p.248), was a species of *Quenstedtia*. *Corbicella* was thus a synonym of *Quenstedtia* and Cox introduced the generic name, *Corbicellopsis* for the *Corbicella* of authors. Arkell (1934b) challenged this view and maintained that the type species of *Corbicella* was *C. complanata* Lycett. However, this species was not included in the genus at the time of its proposal.

Corbicellopsis is essentially a Jurassic genus.

*Corbicellopsis exoni** sp. nov.

Pl.38, figs 5-8

*Named after Mr N.F. Exon of the Bureau of Mineral Resources, who discovered the marine fauna of the Nullawurt Member and collected the type material.

Types: Holotype: CPC9481, an external mould of a right valve. Paratypes: CPC9482 and CPC9483 internal moulds of left valves; CPC9484, an internal mould of a right valve. Locality: Holotype SB221; Paratypes SB210. All specimens from Nullawurt Member, Neocomian.

Material: About 30 internal and external moulds of separated valves and a few specimens with closed valves.

Specific diagnosis: Small; transversely ovate; length about 1.6 times height; umbones broad, fairly prominent, situated slightly in front of mid-length; hinge formula $\frac{3a\quad 3b\quad PI\text{-}PIII}{2\qquad\quad PII}$; 2 and 3a prominent, trigonal shaped, orthocline; 3b laminar, opisthocline; PI and PII short and laminar; pallial sinus wide and shallow; ornament consisting of concentric growth lines.

Description: Small (length 20-25mm). Transversely ovate. Slightly inequilateral. Anterior shorter and narrower than the posterior. Equivalve. Valves closed. Weakly inflated. Antero-dorsal margin straight, sloping. Posterior dorsal margin gently arched. Dorsal margins forming an angle of about 130° at the umbones. Anterior and posterior bluntly rounded. Ventral margin gently convex. Umbones broad, fairly prominent, situated slightly in front of mid-length. Lunule and escutcheon indistinct. Hinge of left valve with a prominent, orthocline cardinal tooth (2) and a well removed, short posterior lateral (PII). Hinge of right valve with two well developed cardinal teeth (3a & 3b), and two short posterior lateral teeth; 3a orthocline, trigonal shaped; 3b smaller, laminar, and opisthocline. No anterior lateral teeth. Ligament external, seated on well developed nymphs. Adductor muscle scars well impressed, subequal, situated close to the hinge margin. Anterior adductor scar elongated and tapered umbonally. Posterior adductor scar rounded. A small pedal muscle scar situated between the anterior adductor scar and the umbonal cavity. Pallial line remote from the margins. Pallial sinus wide and shallow. Ornament consisting of concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype CPC9481	21	9	13	6 (1 valve)
Paratype CPC9482	23	10	13	3 (1 ")
Paratype CPC9483	24	10	15	4 (")
Paratype CPC9484	24	10	16	6 (")

Remarks: *Corbicellopsis exoni* sp. nov. closely resembles *Corbicellopsis claxbiensis* (Woods, 1907, p.157, pl.24, figs 20-23) from the Neocomian of England. The Nullawurt species is a little narrower posteriorly and has finer ornament. Woods appears to have wrongly labelled the valves of the English form. Cox (1929, p.585) thought Wood's species might belong to *Eodonax*, but reference to that genus seems inappropriate.

A superficially similar form described from the Lower Cretaceous Nanutarra Formation of Western Australia by Cox (1961, p.24, pl.3, fig.10) as "*Corbicellopsis*" *nanutarraensis*, has a different cardinal dentition.

Corbicellopsis exoni sp. nov. is very common in collections from the upper part of the Nullawurt Member in the Merivale Syncline. The species may have given rise to *Tatella maranoana* (Etheridge Jnr) by an increase in transverse elongation, a decrease in the prominence of the umbones and loss of the posterior lateral teeth. *Tatella maranoana* occurs abundantly in the immediately overlying Minmi Member.

Occurrence:

Nullawurt Member: SB210; SB211; SB221; SB230.

Age: Neocomian.

Genus Tatella Etheridge Jnr, 1901

Type species (by original designation): Corbicella ? maranoana Etheridge Jnr, 1892, Aptian, Great Artesian Basin.

Generic diagnosis: Equivalve. Thick shelled. Elongately ovate to oblong. Length about twice height. Slightly inequilateral, the anterior end shorter than the posterior. Valves gaping feebly or widely. Umbones not conspicuous, slightly anterior of mid-length. Lunule and escutcheon ill-defined. Cardinal teeth well developed, supported by a strong umbonal callosity or thickening. Hinge formula $\frac{3a\ 3b}{2}$. No lateral teeth. Ligament external, opisthodetic. Nymphs prominent. Anterior adductor scar wedge shaped, tapered umbonally, deeply impressed. Posterior adductor scar bulbous in shape. Umbonal pedal muscle scar a deep pit on the umbonal callosity. Pallial line remote from the margins, with a wide shallow sinus. Ornament of concentric ribs and growth lines.

Range: Aptian - Albian.

Remarks: (1) Affinities: The characters and relationships of Tatella Etheridge Jnr (1901) have been imperfectly understood. Whitehouse (1925) showed that at least two genera and possibly as many as five species were represented among the five specimens referred to the type species by Etheridge Jnr. Whitehouse, following Etheridge Jnr, regarded the pallial sinus in Tatella as shallow. Forms with a deep pallial sinus were

TEXT FIG. 15

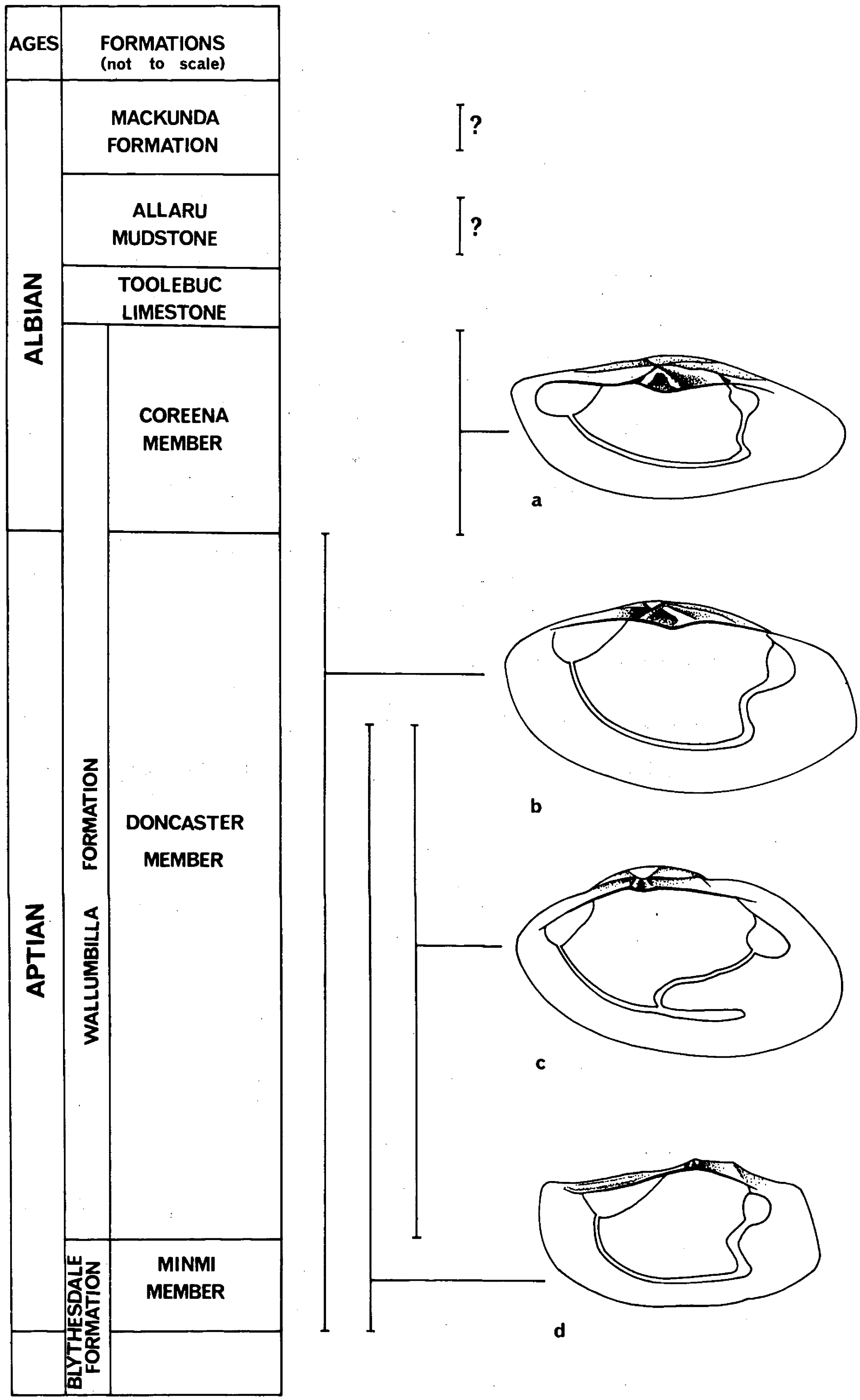
COMPARISON OF HINGE FEATURES, MUSCULATURE, AND RANGES OF SPECIES OF TATELLA, LAEVICANOTIA AND MARANOANA

a Tatella aptiana Whitehouse, F42415AM, interior of right valve, X1.2 (approx.); locality 30 miles N.N.E. of "Tibooburra", Albian.

b Tatella maranoana (Etheridge Jnr), topotype CPC9223, interior of right valve, X1.1 (approx.); locality GAB2098, Doncaster Member, late Aptian.

c Laevicanotia elliptica (Whitehouse), F7855 GSQ, interior of right valve, X1.1 (approx.); locality RD222, same formation.

d Maranoana etheridgei Day, holotype F1315 GSQ, interior of right valve, X1.1 (approx.); locality "Maranoa River half-a-mile above Mitchell Railway Station", same formation.



AGES
FORMATIONS (not to scale)
ALBIAN
APTIAN
MACKUNDA FORMATION
ALLARU MUDSTONE
TOOLEBUC LIMESTONE
WALLUMBILLA FORMATION
COREENA MEMBER
DONCASTER MEMBER
BLYTHESDALE FORMATION
MINMI MEMBER
?
?
a
b
c
d

cardinal dentition, which is bifid in the Garidae and Tellinidae, and very weakly developed in the Quenstedtiidae. Skwarko (1966, p.111) classified Tatella with the Tancrediidae, but erroneously attributed the initial reference to Whitehouse (1925). Day (1967b, p.11) referred Tatella to the Tancrediidae because of its close relationship with the tancrediid Corbicellopsis Cox (1929).

In shape Tatella resembles the elongately ovate tancrediids Corbicellopsis Cox (1929) and Sakawanella Ichikawa (1950). However, Tatella is readily distinguished by its lack of lateral teeth, well formed pallial sinus, and internal thickening in the umbonal cavity.

(2) Functional morphology: The interpretation of the functional morphology of fossil tellinacean genera by analogy with living relatives is fully discussed in the section on Laevicanotia gen. nov., and need not be repeated here.

The laterally compressed, transversely elongated shape of Tatella suggests that the genus was an active burrower. The foot was probably large, as the shell is considerably elongated in front of the umbones. A prominent muscle scar on the umbonal callosity may be that of a pedis elevator, although that muscle is inserted more anteriorly on the shells of living Donacidae (Graham, 1934). Tatella has a shallow pallial sinus, quite unlike those of existing donacid genera.

This probably indicates lesser development of siphons, which in turn suggests that Tatella was not a deep burrower.

In a few instances such a deduction is not valid. The suspension feeding Solenacea are deep burrowers but have only short siphons. The foot is specially modified to allow the animal to be rapidly withdrawn into its burrow (Yonge, 1949). However, members of the Solenacea are readily recognised by their markedly elongated posteriors and their large length-height ratios. The living myid Cryptomya californica is a deep burrower with short siphons, no pallial sinus and a reduced siphonal gape. This animal utilizes burrows made by other organisms (Yonge, 1952). Living members of the Lucinidae described by Allen (1958) are siphonate but have no pallial sinus as the siphon is turned inside out on retraction. The latter two are probably rare, exceptional cases.

The common occurrence of Tatella as separated valves in coquina-like deposits in sandstones, siltstones and mudstones offers additional evidence of a shallow burrowing habit.

Tatella aptiana was possibly a more efficient burrower than T. maranoana. The former's shape is more streamlined, with almost straight, subparallel dorsal and ventral margins, and inflation that increases from a minimum anteriorly to a maximum behind the umbones, then diminishes rapidly. The frontal gape indicates that the foot protruded anteriorly. Possibly the siphons were not as retractable as in *Tatella maranoana*, for the siphonal gape is wide. The latter suggests that the mantle cavity extended beyond the posterior limits of the shell. In appearance *Tatella aptiana* approaches Recent members of the tellinacean families Solecurtidae and Novaculinidae which live in deep vertical burrows in stable muddy substrates rich in organic detritus. *T. aptiana* may have been adapted to a similar, though shallower, burrowing existence.

Maranoana etheridgei has a compressed oblong shape and gapes anteriorly and posteriorly like *Tatella aptiana*. However, the anterior end of *M. etheridgei* is much longer than the posterior.

The pallial line in *Tatella* extends above the adductor muscle scars towards the umbonal cavity. As discussed in the section of *Laevicanotia elliptica*, this probably indicates that fusion layer was not extensively developed in the ligament. Occurrences of widely opened valves with unruptured ligaments and rarer fragments of the umbonal region of the shell still joined together by ligament testify to the strength of that structure.

Tatella maranoana (Etheridge Jnr), 1892

Pl.40, figs 1-16; text fig.15b

Synonymy:

1892 Corbicella ? maranoana Etheridge Jnr, p.471 (pars.), pl.27, figs 4-5 only.

1901 Tatella maranoana (Etheridge Jnr), p.28 (pars.).

1925 Tatella maranoana (Etheridge Jnr); Whitehouse, p.33.

1925 Tatella ? aptiana Whitehouse, pl.1, figs 9-10 only.

1960 Tatella maranoana (Etheridge Jnr); Day, p.311.

1964 Tatella maranoana (Etheridge Jnr); Day, p.18, table 3.

1964 Tatella ? aptiana Whitehouse; Day, p.18, table 3.

?1966 Tatella aptiana Whitehouse; Ludbrook, pl.24, fig.2 only.

1966 Tatella elliptica (Whitehouse); Ludbrook, pl.24, fig.6 only.

?1966 Tatella spp. aff. T. ? aptiana Whitehouse; Skwarko, p.111, pl.10, figs 5-7 only.

1967a Tatella maranoana (Etheridge Jnr); Day, p.10.

1967b Tatella maranoana (Etheridge Jnr); Day, p.12, pl.1, figs 24-26.

Type: Holotype: F1314 GSQ. Locality: "Maranoa River, half a mile above Mitchell Railway Station", Doncaster Member, upper Aptian.

Material: About 100 internal and external moulds and a few specimens retaining shell material.

Specific diagnosis: Elongately ovate Tatella; length about

1.8 times height; dorsal margins straight, forming an angle of approximately 155° at the umbones; ventral margins convex; valves with slight posterior gape; maximum inflation below umbones.

<u>Description</u>: Thick shelled. Elongately ovate; length about 1.8 times shell height.

Equivalve. Moderately inflated, maximum inflation below the umbones, diminishing evenly anteriorly and posteriorly. Almost equilateral; dorsal margins straight, sloping, meeting at an angle of approx. 155° at the beak. Ventral margins convex. Anterior and posterior tapered, then bluntly rounded; posterior obliquely truncate, gaping slightly. Umbones broad, depressed, not conspicuous, a little anterior of mid-length. Beaks small, weakly prosogyral. Lunule linear. Escutcheon small, narrow. Hinge plate well developed, supported by an internal thickening or callosity in the umbonal cavity. Left valve with a single, slightly opisthocline cardinal tooth (2), conical and upturned distally. Right valve with two cardinal teeth (3a, 3b); 3a orthocline to slightly prosocline; 3b opisthocline, larger than 3a. Lateral teeth absent. Ligament external, opisthodetic, seated on prominent nymphs. Anterior adductor scar wedge shaped, tapering umbonally, deeply impressed. Posterior adductor scar bulbous in shape, attenuated dorsally. Umbonal pedal scar of left valve a deep pit on the umbonal callosity immediately ventral to the cardinal tooth (2); corresponding scar of the right valve situated behind the umbonal callosity and within the umbonal cavity. Pallial line continued dorsally above the adductor scars, remote from the margins. Pallial sinus wide and shallow. Exterior ornamented with fine concentric growth lines, and less regularly spaced, weak concentric ribs, which are equally developed anteriorly and posteriorly. In larger specimens radial striae interrupted by concentric ribs occur near the postero-ventral margins.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype F1314 GSQ	55	23+	25	10 (1 valve)
Topotype F7854 GSQ	58	26	30	12 (")
Topotype F7852 GSQ	46	21	22	8 (")
Topotype F7851 GSQ	40	18	21	7 (")
Topotype F7850 GSQ	35+	17	23	7 (")
Topotype CPC9223	48	21	24	8 (")
CPC9222	55	20	31	-
F35830 UQ	48	20	25	-
F35608 UQ	47	20	24	6 (")
F35829 UQ	42+	-	26	7 (")
F35571 UQ	42	19	23	5 (")
F35543 UQ	34	14	19	5 (")

Remarks: *Tatella maranoana* (Etheridge Jnr) has been confused with *Tatella aptiana* Whitehouse, *Laevicanotia elliptica* (Whitehouse), *Maranoana etheridgei* Day, and *Palaeomoera* ?

milligani sp. nov. All except Tatella aptiana, which is an Albian species, occur at the type locality of T. maranoana, "Maranoa River half-a-mile above Mitchell Railway Station".

Whitehouse (1925, p.33) from an inspection of figures of Tatella maranoana given by Etheridge Jnr (1892) (1901) (1902a) recognised that only the holotype figured in 1892 (pl.27, figs 4-5) as Corbicella ? maranoana represented the species. He referred the other specimen figured in 1892 (pl.28, figs 2-3) to Tatella sp. Forms illustrated by Etheridge Jnr (1901, pl.1, fig.5; pl.3, fig.4) (1902a, pl.3, figs 28-29) and (1901, pl.2, fig.8) (1902a, pl.2, fig.25) Whitehouse respectively named Tatella ? aptiana and Gari elliptica. He also called a specimen figured by Etheridge Jnr (1902a, pl.2, fig.26) Gari ? sp.

Whitehouse's subdivision is essentially the same as that now adopted. However, Gari ? sp. is considered conspecific with Tatella sp. (=Maranoana etheridgei Day) and specimens figured by Whitehouse (1925, pl.1, figs 9-10) as Tatella ? aptiana are referred to T. maranoana.

The shape and/or the pallial characters of Tatella maranoana have been differently interpreted by Etheridge Jnr (1901), Whitehouse (1925) and Ludbrook (1966). This is not surprising, as the holotype of the species (F1314 GSQ) is an antero-dorsally damaged left valve, which, while displaying some hinge features, does not show the pallial sinus. Topotypic material described above clearly shows that Tatella maranoana has submedian umbones, gently sloping antero-dorsal margins, a slight posterior gape, and a shallow pallial sinus.

Tatella aptiana is closely related to T. maranoana. The two have submedian umbones, comparable dentition, pallial characters, and adductor and pedal musculature. However, T. aptiana gapes widely anteriorly and posteriorly, and the antero-dorsal and ventral margins are straight and subparallel.

Comparatively small specimens from the Roma-Wallumbilla area identified as Tatella ? aptiana by Day (1964, p.18, table 3) are now considered conspecific with T. maranoana.

Maranoana etheridgei, which has a shallow pallial sinus and adductor muscle scars like those of Tatella maranoana, is distinguished by its oblong shape, wide anterior and posterior gapes, posterior umbones and reduced dentition.

The deep pallial sinus of Laevicanotica elliptica and Palaeomoera ? milligani clearly separate those species from Tatella maranoana. In addition Palaeomoera ? milligani has different cardinal dentition and the slope of the dorsal margins is steeper, while Laevicanotica elliptica has anterior umbones.

The specimen (M1584 GSSA) figured by Ludbrook (1966, pl.24, fig.4) as Tatella elliptica is a typical representative of Tatella maranoana, but that figured as Tatella aptiana (pl.24, fig.2) (M1616 GSSA) is only doubtfully included in the species since its preservation is poor.

Specimens CPC5016-5018 described by Skwarko (1966, pl.10, figs 5-7) from the Mullaman Beds as *Tatella* ? spp. aff. *T.* ? *aptiana* and ? *Tatella* ? *aptiana* are poorly preserved, but may be conspecific with *Tatella maranoana*. CPC5016 (pl.10, fig.5) is however, an internal mould of a left, not a right valve. Two other specimens CPC4967 and CPC4768 figured by Skwarko (1966, pl.10, figs 8-9) under the same name are probably not identifiable.

Occurrence:

Minmi Member: RD78; RD82; RD94; RD99; RD107; RD109; RD128; RD207; RD283; RD285; L269 GSQ; L2162 UQ; SB107; SB118; SB122; SB128; SB203; SB207; SB209; SB264; GAB1950.

Doncaster Member: "Maranoa River, half-a-mile about Mitchell Railway Station" (Etheridge Jnr, 1892); RD5; RD87; RD90; RD92; RD124; RD221; RD222; RD243; L98 GSQ; L99 GSQ; SB117; GAB1803; GAB1831; GAB2089?; GAB2098; GAB2102; GAB2115; BMR Richmond 2 (247'2"-247'4").

Coreena Member: GAB1933 (Remanie occurrence).

Maryborough Formation: Yengarie and Corporation Quarries (GSQ collections).

Maree Formation: Hamilton 5/530/1; Neales 5/582/1 ? (Ludbrook, 1966).

Mullaman Beds: TT21? (Skwarko, 1966).

Age: Early - late Aptian.

Tatella aptiana Whitehouse, 1925

Pl.40, figs 17-27; text fig.15a

Synonymy:

1901 Tatella maranoana (Etheridge Jnr), pl.1, fig.5; pl.3, fig.4 only.

1902a Tatella maranoana (Etheridge Jnr), pl.3, figs 28-29 only.

1925 Tatella ? aptiana Whitehouse, p.33 only.

Type: Holotype: T1286 AUGD. Locality: "Lake Eyre Basin", Maree Formation, Albian.

Material: Two internal moulds of right valves, two internal moulds of left valves, a dorsally incomplete specimen with closed valves, and anteriorly incomplete right valve and a posteriorly incomplete right valve.

Specific diagnosis: Elongately oblong Tatella; length about 2.25 times shell height; dorsal margins meet an angle of approx. 170° at the umbones; ventral margins nearly straight; valves gaping widely anteriorly and posteriorly.

Description: Thick shelled. Elongately oblong; length about 2.25 times shell height. Equivalve. Weakly inflated, maximum inflation behind the umbones. Slightly inequilateral. Dorsal margins meeting at an angle of approx. 170° at the umbones. Antero-dorsal margins straight, sloping very gently. Postero-dorsal margins feebly convex, sloping steeply. Ventral margins nearly straight, almost parallel to the antero-dorsal margin. Shell truncate anteriorly and posteriorly, gaping widely at both ends. Umbones broad, depressed, not conspicuous, slightly anterior of mid-length. Lunule and escutcheon poorly developed. A very weak carina extends from the umbo to the postero-dorsal extremity. Hinge plate thickened and supported by a strong umbonal callosity. Left valve with a single, orthocline tooth (2), conical and upturned distally. Right valve with two cardinal teeth (3a, 3b); 3a prosocline, 3b opisthocline, larger than 3a. Lateral teeth absent. Ligament external, opisthodetic, supported by prominent nymphs. Adductor muscle scars, pedal muscle scar and pallial characters as in Tatella maranoana. Exterior ornamented with fine concentric growth lines and more prominent, irregularly spaced, concentric ribs which are equally developed anteriorly and posteriorly. Small radial striae occasionally occur near the posterior margins.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Holotype	T1286 AUGD	43	19	20	11 (1 valve)
	F42415 AM	45	21	19	8 (")
	CPC9218	62	-	24+	-
	CPC9219	48+	-	24	5 (")
	CPC9221	38+	-	19	5 (")
	CPC9220	14	6	6	-
	CPC9217	9	4	4	-

Remarks: Whitehouse (1925, p.33) tentatively referred Tatella aptiana to the genus Tatella. However, such reservation is unnecessary as *T. aptiana* is very closely related to the type species *T. maranoana* differing only in its oblong shape and wide anterior and posterior gapes.

The holotype of *Tatella aptiana* (T1286 AUGD), an internal mould of closed valves, was figured by Etheridge Jnr in 1901 (pl.1, fig.5; pl.3, fig.4) and again in 1902 (pl.3, figs 28-29). In 1901 its locality was inferred to be "Maranoa River half-a-mile above Mitchell Railway Station"; in 1902 its correct locality "Lake Eyre Basin" was given.

Apart from those of the holotype, all published illustrations of *Tatella aptiana* are misidentifications. Specimens figured by Whitehouse (1925, pl.1, figs 9-10), belong to *Tatella maranoana*. Ludbrook's (1966) illustrations represent *Laevicanotia elliptica* (pl.24, fig.5) and possibly *Tatella maranoana* (pl.24, fig.2). Some of those doubtfully referred to *Tatella aptiana* by Skwarko (1966) may represent *Tatella maranoana*, while others are probably unidentifiable.

Tatella aptiana belies its name and is an Albian species. It occurs with an Albian Tambo fauna in the Coreena Member and the Allaru Mudstone. A single, anteriorly incomplete right valve which has a slightly deeper sinus than typical specimens provides a possible record of the species in the Mackunda Formation.

Solecurtus sp. described by Kitchin (1913, p.155, text fig.1) from the Uitenhage Beds of South Africa is similar in outline to Tatella aptiana, but its hinge is unknown.

Occurrence:

Coreena Member: GAB1433; GAB2087?; GAB2088?; SB108?; SB111.

Allaru Mudstone: GAB2033; BMR Longreach 4 (222'2½"-222'4").

Mackunda Formation: GAB1304?

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a).

N.S.W.: 30 miles N.N.E. of Tibooburra (AM collections).

Age: Early - early late Albian.

Genus Maranoana Day, 1967

Type species (by original designation): Maranoana etheridgei Day, 1967, Aptian, Great Artesian Basin.

Generic diagnosis: Thin shelled. Elongated, oblong shaped, with a rostrate antero-dorsal extremity. Length about twice height. Compressed; equivalve. Inequilateral. Gaping anteriorly and posteriorly. Umbones inconspicuous, situated three-fifths of shell length from the anterior end. Lunule and escutcheon wanting. Posterior margin truncate, slightly oblique. Left valve with a small orthocline cardinal tooth (2). Right valve with two minute cardinal teeth (3a, 3b). Lateral teeth absent. Ligament external, opisthodetic; seated on long nymphs. Adductor scars not well impressed. Anterior scar wedge shaped, tapering umbonally. Posterior scar rounded. Pallial line with a wide, shallow sinus. Ornament of broad, weakly elevated, irregularly spaced concentric ribs, and fine concentric lines of growth.

Range: ?Neocomian-Aptian.

Remarks: (1) Affinities: The genus *Maranoana* Day (1967b, p.12) differs from the related genus *Tatella* Etheridge Jnr (1901) in its rostrate antero-dorsal extremity and posterior umbones. The Albian-Maestrichtian genus *Meekia* Gabb and its subgenus *Mygallia* Saul and Popenoe (1962) from the west coast of North America and Japan resemble *Maranoana* in their anterior gape and antero-dorsal rostration. Transversely elongated forms with posterior umbones figured by Saul and Popenoe (1962, pl.6, figs 8-11) as '*Meekia*' *navis* Gabb are especially similar. However, these younger forms have probably evolved independently as all have a more developed dentition than *Maranoana*. The shared peculiarities of *Maranoana*, *Meekia*, *Meekia* (*Mygallia*) and the genus represented by '*Meekia*' *navis* suggest that all were adapted to a similar mode of life.

Quenstedtia Morris and Lycett has a reduced dentition (Arkell, 1933, text figs 69-70) resembling that of *Maranoana*. If the anterior end of the latter is mistaken for the posterior, specimens of the two genera may be confused. However, unlike *Maranoana* which has posterior umbones and a shallow pallial sinus, the umbones of *Quenstedtia* are anterior and the pallial sinus is deep.

Maranoana is at present an endemic genus. It is represented in Australia by the type species of Aptian age, and perhaps by an unnamed species of probable Neocomian age.

(2) _Functional Morphology_: Some aspects of the morphology of _Maranoana_ may be interpreted in terms of function. The anterior elongation of _Maranoana_ implies that the foot was large, the pallial sinus indicates the existence of siphons, while the posterior gape possibly suggests that the siphons were only partially retractable. Considered in conjunction with the compressed oblong form, these features indicate that _Maranoana_ was adapted to an active burrowing life. In living tellinacean and genera the enlarged foot and attendant elongation of the shell are associated with the capacity to burrow deeply and move horizontally through the deposits on which they feed (Owen, 1959). Possibly, the mode of life of _Maranoana_ was broadly similar, although some differences are apparent. The anterior gape of _Maranoana_ suggests that the foot protruded very anteriorly. This is usually a feature of forms that burrow vertically. Furthermore, _Maranoana_ unlike living tellinaceans has only a shallow pallial sinus. This may indicate lesser development of siphons, which may, in turn, be correlated with shallower burrowing habits. The common occurrence of separated valves of _Maranoana etheridgei_ in coquina-like deposits in sandstones, siltstones and mudstones also suggests that the species was a shallow burrower.

Maranoana etheridgei Day, 1967

Pl.39, figs 1-4; text fig.15d

Synonymy:

1892? Corbicella ? maranoana Etheridge Jnr, p.471 (pars.), pl.28, figs 2-3 only.

1901 Tatella maranoana (Etheridge Jnr), p.28 (pars.).

1902a Tatella maranoana (Etheridge Jnr), pl.2, fig.26 only.

1925 Tatella sp. Whitehouse, p.33.

1925 Gari ? sp. Whitehouse, p.33.

1961 Tatella sp. Woods, p.6.

1964 Tatella ? sp. Day, p.18, table 3.

1964 Solemya sp. Day, p.14, table 3.

1966 Tatella elliptica (Whitehouse); Ludbrook, pl.24, figs 3,4,7 only.

1967b Maranoana etheridgei Day, p.13, pl.3, figs 15-19.

Types: Holotype: F1315 GSQ. Locality: 'Maranoa River half-a-mile above Mitchell Railway Station', Doncaster Member, upper Aptian.

Material: Two specimens with closed valves, two with opened but unseparated valves and eighteen internal and external moulds of separated valves.

Specific diagnosis: Elongated, oblong shaped Maranoana; length about twice height; antero-dorsal extremity rostrate; umbones posterior.

Description: Medium to large in size (length 20-65 mm).

Thin shelled. Oblong shaped; length about twice height. Weakly inflated. Gaping anteriorly and posteriorly. Inequilateral; anterior comprising approximately three-fifths of shell length. Umbones posterior, inconspicuous. Lunule and escutcheon wanting. Antero-dorsal margins straight or slightly concave, almost parallel to the ventral margins. Postero-dorsal margins straight, meeting the antero-dorsal margins at an angle of about 170°. Posterior margin truncate, slightly oblique. Anterior margin convex. Antero-dorsal extremity rostrate. Hinge line thickened, particularly anteriorly. Anterior thickened area tapers towards the umbo and is bounded above and below by a slightly raised rim or flange. Left valve with a small, orthocline cardinal tooth (2). Right valve with two minute cardinal teeth (3a, 3b), flanking the socket that receives the cardinal tooth of the left valve. Ligament external, probably opisthodetic. Adductor scars dorsal, not well impressed. Anterior adductor scar wedge shaped, tapering umbonally. Posterior adductor scar rounded. Pallial line with a shallow sinus. Exterior with broad, weakly elevated, irregularly spaced ribs 1-3mm apart, and very fine concentric growth lines.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Holotype	F1315 GSQ	38	23	18	-
	F35567 UQ	33	19	15	3 (1 valve)
	CPC9216	26	16	12	-
	F28842 UQ	40	24	20	5 (")
	F35570 UQ	65	c.38	28	8
	F35572 UQ	62	-	29	-
	F7861 A/B GSQ	40	26	20	-

Remarks: The holotype (F1315 GSQ), an internal mould of a specimen with valves in apposition, was identified by Etheridge Jnr (1892, pl.28, figs 2-3) as *Corbicella ? maranoana* in the plate explanation, but was only doubtfully referred to that species in the text (p.471). Subsequently, Etheridge Jnr (1901, p.28) proposed the genus *Tatella* for *Corbicella ? maranoana* and included the specimen (F1315 GSQ) in that species without reservation. However, Etheridge Jnr had wrongly orientated F1315 GSQ. That specimen displays a pallial sinus which indicates that the illustration given by Etheridge Jnr (1892, pl.28, fig.2) represents a right, not a left valve. Whitehouse (1925, p.33) separated the form from *Tatella maranoana* as *Tatella* sp. Day (1967b, p.12) designated F1315 GSQ holotype of *Maranoana etheridgei*.

Maranoana etheridgei is represented in South Australia by a specimen (T1285A AUGD) figured by Etheridge Jnr (1902a, pl.2, fig.26) as *Tatella maranoana* and subsequently referred to

Gari ? sp. by Whitehouse (1925, p.33), and by two specimens (M1613 GSSA and M1726 GSSA) illustrated by Ludbrook (1966, pl.24, figs 3,4,7) as Tatella elliptica.

During preliminary examination some small internal moulds from the Minmi Member were identified as ? Solemya sp. The posterior truncation of these is not as oblique as that of specimens of Maranoana etheridgei from the Doncaster Member. Apart from this the Minmi and Doncaster specimens are very similar and the former were included in M. etheridgei by Day (1967b, p.13).

Maranoana etheridgei Day may be confused with the Albian species Tatella aptiana Whitehouse as both gape anteriorly and posteriorly, are oblong shaped and have similar musculature and pallial features. However, unlike T. aptiana, M. etheridgei is longer anteriorly than posteriorly, and the dentition is much weaker than that of T. aptiana.

The distinctions between Tatella maranoana and Maranoana etheridgei have already been discussed.

Occurrence:

Minmi Member: Burns well (60 ft?), por. 90, Kangaroo Ck; RD99; RD128; RD205; RD207; L141 GSQ; L142 GSQ; L319 UQ; L2162 UQ; SB118; SB122; SB128.

Doncaster Member: "Maranoa River, half-a-mile above Mitchell Railway Station" (Etheridge Jnr, 1892); RD117; RD198; RD221; RD222; L97 GSQ; GAB1115; GAB2162; BMR Richmond 2 (221'9"-221'11").

Maryborough Formation: Yengarie quarry (GSQ collections).

Blackdown Formation: W3; W8; W23 (Woods, 1961).

Maree Formation: "Peake, central South Australia" (Etheridge Jnr, 1902a); Kewson 5/633/1 and Bopeechee 5/644/1 (Ludbrook, 1966).

Age: Early - late Aptian.

Maranoana ? sp.

Pl.39, figs 5-7

Material: An antero-dorsally incomplete external mould of a right valve, a posteriorly incomplete internal mould of a left valve, an internal mould the umbonal region of a left valve, and possibly a few fragmentary specimens.

Description: Large (length 60-70 mm). Elongately oblong; length more than twice height. Equilateral. Weakly inflated. Probably gaping anteriorly and posteriorly. Antero-dorsal margins straight, parallel to ventral margins. Postero-dorsal margins slightly sloping. Anterior bluntly rounded. Posterior vertically truncate. Umbones inconspicuous, sub-central. Hinge line thickened anteriorly and posteriorly, the thickened areas tapering umbonally. Hinge line damaged immediately beneath the umbo. Ligament external, seated on long, narrow nymphs. Anterior adductor scar triangular, well impressed. Posterior adductor scar not observed. Pallial line deeply impressed anteriorly, not known posteriorly.

Ornament consisting of concentric, regularly spaced depressions about 2 mm apart and fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
CPC9301	68	c.35	28	5 (1 valve)

Remarks: Maranoana ? sp. is probably a new species but it is not named specifically because the available material is very limited and is not well preserved. The species is referred to the genus Maranoana with some reservation as the hinge features are incompletely known. The present specimens from the Nullawurt Member differ from the type species of Maranoana, M. etheridgei, in their median umbones and vertical posterior truncation. The edentulous solenid Senis Stephenson (1952) from the Cenomanian of Texas and the Aptian and Albian of England (Casey, 1961c) is similar in appearance but is more elongated.

Specimens reported by Woods (1963a) from the 'crossing of the Normanby River, 1.3 miles north-west of Lakefield homestead' (Battle Camp Formation, Laura Basin) as ? Tatella sp. nov A are very similar and may be conspecific. At the Normanby River locality ? Tatella sp. nov. A was associated with the Neocomian ammonite Hatchericeras lakefieldense Woods (1962a).

Occurrence:

Nullawurt Member: SB221; SB230.

Age: Neocomian.

Suborder VENERINA Vokes, 1967

Superfamily GLOSSACEA Gray, 1847

Family Glossidae Gray, 1847

Remarks: Genera included in the Glossidae (=Isocardiidae) have comparatively thick shells, are equivalved, well inflated, orbicular or transversely ovate in outline, and usually have carinate valves and umbones that are twisted in a prosogyral spiral. The dentition is distinctive and consists of laminar cardinal teeth that tend to parallel the hinge margin, inconstant, remote, posterior lateral teeth and rarely developed, weak, anterior lateral teeth. The ligament is external, seated on strong nymphs, the pallial line is entire or slightly sinuate, and the ornament consists of fine concentric ribs and growth lines.

The family is essentially a modern one with its earliest members known from the Jurassic. The list of glossid genera given by Vokes (1967) does not include the genera Ambocardia, Ankistrocardia, Megalocardia, and Platycardia all proposed by Beringer (1949).

Genus Fissilunula Etheridge Jnr, 1902

Type species (by monotypy): Cytherea clarkei Moore, 1870, Aptian, Australia.

Generic diagnosis: Large. Thick shelled. Somewhat cyprinoid in appearance. Equivalve. Inequilateral. Weakly inflated. Umbones broad, not twisted in a spiral. Beaks small, prosogyral, situated in the anterior two-fifths of shell. Lunule wide, crossed by a shallow groove. Escutcheon narrow, deeply impressed. Valves non-carinate. Hinge formula

$\dfrac{1\quad 3b\quad PI\quad PIII}{2a\quad 2b\quad 4b\quad PII}$; 2a strong, knob-like; 2b more prominent, opisthocline; 4b smaller, very opisthocline; 1 strong, knob-like, opisthocline; 3b laminar, very opisthocline. Anterior lateral teeth not developed. Posterior lateral teeth remote from the cardinals; PI and PII long, narrow, curved; PIII formed by the shell margin. Ligament seated on prominent nymphs. Adductor scars large, ovate. Pallial line with a wide, very shallow sinus. Ornament consisting of fine concentric ribs and growth lines.

Range: Aptian - Albian.

Remarks: In proposing the genus *Fissilunula* Etheridge Jnr (1902b, p.33) stated "*Fissilunula* broadly speaking, seems to be an ally of the *Isocardia* group, but generally does not agree with any member of that family known to me". Subsequently, Newton (1915, p.223) referred the genus to the family Cyprinidae (=Arcticidae) without comment. Brunnschweiler (1960, p.32) commented on the similar appearance of certain astartid and cyprinid genera, although he still included *Fissilunula* in the Isocardiidae.

Etheridge Jnr on the basis of hinge features, ably demonstrated the relationship between *Glossus* (=*Isocardia*) and *Fissilunula*. The genus differs from typical members of the Glossidae in that the beaks are neither prominent, nor twisted in a prosogyral spiral, the valves are not carinate and the cardinal teeth are not as laminar. The lunule furrow from which Fissilunula derives its name is not unlike those seen in many species of Glossus.

As noted by Day (1967b, p.15) the pallial sinus of the type species of Fissilunula is shallow. The specimen with a deep pallial sinus mentioned by Etheridge Jnr (1902b, p.36) is a representative of Tancretella plana (Moore).

Fissilunula is at present an endemic genus. It is represented by one widely distributed Aptian species (F. clarkei) and by an Albian species (F. coreenaensis sp. nov.).

Fissilunula clarkei (Moore), 1870

Pl.42, figs 6-7

Synonymy:

1870 Cytherea clarkei Moore, p.250, pl.13, fig.1.

1872 Cyprina expansa Etheridge Snr, p.338, pl.19, fig.1.

1887 Cytherea ? clarkei Moore; Tate, p.53.

1889 Cytherea clarkei Moore; Tate, p.230.

1892 Cyprina clarkei (Moore); Etheridge Jnr, p.474, p.568, pl.26, figs 18,19; pl.27, figs 9,11 only.

1892 Ceromya ? sp. ind. Etheridge Jnr, p.571, pl.26, fig.20.

1902a Cyprina ? (vel Cytherea) clarkei (Moore); Etheridge Jnr, p.32, pl.6, figs 1,2.

1902b Fissilunula clarkei (Moore); Etheridge Jnr, p.36, pl.6, fig.3; pl.9, fig.1; pl.10, figs 1,2; pl.11, figs 1,2.

1915 Fissilunula clarkei (Moore); Newton, p.223, text figs A,B.

1927 Fissilunula clarkei (Moore); Whitehouse p.146.

1960 Fissilunula clarkei (Moore); Brunnschweiler, p.30, pl.2, figs 8,9; text figs 23,24.

1960 Fissilunula cf. clarkei (Moore); Day, p.311.

1961 Fissilunula clarkei (Moore); Woods, p.6.

1964 Fissilunula clarkei (Moore); Day, table 3.

1965 Fissilunula clarkei (Moore); Day, p.418.

1966 Fissilunula clarkei (Moore); Ludbrook p.174, pl.23, fig.19.

1966 Fissilunula clarkei (Moore); Skwarko, p.106, pl.13, figs 6,8.

1967a Fissilunula clarkei (Moore); Day, p.10.

1967 Fissilunula clarkei (Moore); Skwarko, p.19, pl.1, figs 9,10.

1967b Fissilunula clarkei (Moore); Day, p.14, pl.2, figs 5-6, text fig.3a,b.

Types: Cytherea clarkei Moore. Lost. Locality: "Maranoa River", "Wollumbilla", and "Gregory River north of Finnis Springs on Stuart's route from Adelaide to Chambers Bay".

Neotype: (herein designated) F7858 GSQ, an internal mould of a left valve. Locality: RD222, Doncaster Member, upper Aptian.

Cyprina expansa Etheridge Snr. Lectotype: F1250 QM. Locality: "Maryborough", Maryborough Formation, Aptian.
Material: About 50 internal moulds, several external moulds and a few specimens retaining thick shell material.
Specific diagnosis: Large, thick shelled, ovately rhomboidal *Fissilunula* with broad, prominent umbones, situated in the anterior two-fifths of the shell.
Description: Large (length 40-150mm). Thick shelled. Inflation variable, usually weak; maximum inflation in the umbonal region. Ovately rhomboidal in shape. Equivalve. Inequilateral. Antero-dorsal margin straight, sometimes concave, slightly sloping. Other margins gently convex. Umbones not twisted in a spiral, broad, elevated. Beaks small, somewhat flattened, prosogyral, situated in the anterior two-fifths of shell. Lunule wide, shallow, crossed by a groove extending from the beak to the anterior cardinal tooth. Escutcheon narrow, deeply impressed. Valves non-carinate. Dentition as for genus. Ligament seated on prominent nymphs. Adductor scars large, ovate. Pallial line with a wide, but very shallow pallial sinus. Ornament consisting of fine concentric ribs and growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Neotype F7858 GSQ	125	48	100	25 (1 valve)
F1250 QM	140+	-	130+	64
F3849 QM	120	46	80+	25 (")
F7898 GSQ	96	38	71	20 (")
F7899 GSQ	104	42	82	22 (")
CPC9311	90	36	70	20 (")

Remarks: Moore's types were lost in the Garden Palace fire in Sydney in 1882 (Etheridge Jnr, 1892, p.xvi). The topotype (F7858 GSQ) now selected as neotype is an internal mould of a left valve, which closely approaches the form figured by Moore (1870, pl.13, fig.1).

As Etheridge Jnr (1902b) observed the height and inflation of *Fissilunula clarkei* are somewhat variable. However, very tumid forms figured from South Australia by Etheridge Jnr (1902a, pl.8, figs 5-6) appear to be specifically distinct.

The mode of preservation also alters the appearance of *Fissilunula clarkei*. On internal moulds the very flattened postero-ventral and antero-dorsal areas are commonly incompletely preserved, while the degree of incompleteness is not readily apparent. The umbones are always broad and prominent, but not markedly elevated.

Smaller, ovate specimens may be confused with *Tancretella* _plana_ (Moore). This was the case with the deeply sinupalliate variety reported by Etheridge Jnr (1902b, p.36). The specimen in question (F1326 GSQ) which was figured by Etheridge Jnr (1892, pl.27, fig.10) as _Cyprina clarkei_ ? (Moore) is a typical representative of _Tancretella plana_.

The hinge of the right valve illustrated by Etheridge Jnr (1902b, pl.10, fig.2) does not show the 3b cardinal tooth, although it occurs in hinges of all specimens examined in the present study. Its absence from Etheridge's specimen may result from imperfect preservation.

Tate (1889, p.230) and Etheridge Jnr (1892, p.474) considered that _Cyprina expansa_ Etheridge Snr (1872, pl.19, fig.1) from "Maryborough" was conspecific with Moore's species. This view is accepted here. Another "Maryborough" form figured by Etheridge Jnr (1892, pl.26, fig.20) as _Ceromya_ ? sp. ind. is probably a distorted specimen of _Fissilunula clarkei_.

Occurrence:

Minmi Member: "Minmi near Roma" (Etheridge Jnr, 1892); RD26; RD207; GAB1942; GAB1950; SB200; SB203; SB207; SB209; SB226; SB227; SB231.

Doncaster Member: "Maranoa River"; "Wollumbilla" (Moore, 1870); "Upper Flinders River" (Etheridge Jnr, 1892); "Roma Downs homestead portion 4" (Whitehouse, 1927); RD87; RD90; RD92; RD116; RD117; RD122; RD124; RD210; RD222;

L98 GSQ; L156 GSQ; GAB1117; GAB1134; GAB1145; GAB1831; GAB2098; GAB2101?; GAB2102; GAB2115; SB110?; SB116.

Jones Valley Member: GAB1139.

Coreena Member: GAB1933 (remanie).

Blackdown Formation: "Walsh River" (Etheridge Jnr, 1892); and several localities reported by Woods (1961).

Maryborough Formation: "Maryborough" (Etheridge Snr, 1872).

Maree Formation: Several localities reported by Etheridge Jnr (1902a) and numerous localities reported by Ludbrook (1966).

N.S.W.: White Cliffs (Newton, 1915) and several localities reported from north-west N.S.W. by Etheridge Jnr (1902b).

W. Aust.: Melligo Sandstone (Brunnschweiler, 1960); Gibson Desert (Skwarko, 1967).

Age: Early - late Aptian.

*Fissilunula coreenaensis** sp. nov.

Pl.42, figs 1-5

*Named after the Coreena Member of the Wallumbilla Formation.

Types: Holotype:CPC9366, an internal mould of a specimen with closed valves. Paratypes: CPC9368, an internal and external mould of closed valves; CPC9367, a ventrally incomplete internal mould of a left valve; CPC9369, a posteriorly incomplete right valve. Locality: Holotype: CPC9366 and paratypes CPC9367, CPC9368, GAB2107; Paratype:

CPC9369, GAB1433. All specimens from the Coreena Member, lower Albian.

Material: About 20 specimens, mainly preserved as internal moulds of closed valves.

Specific diagnosis: Medium sized, well inflated, transversely ovate *Fissilunula* with narrow depressed umbones situated in the anterior one-third of the shell.

Description: Medium sized (length 30-60mm). Thick shelled. Well inflated; maximum inflation behind the umbones. Transversely ovate. Equivalve. Inequilateral. Antero-dorsal margin straight, sloping. Postero-dorsal margin weakly arched. Anterior and posterior bluntly rounded. Ventral margin gently convex. Umbones narrow, depressed, situated in the anterior one-third of shell. Beaks small, prosogyral. Lunule wide. Escutcheon lanceolate. Hinge features not well preserved. Left valve cardinal teeth 2a and 2b small, knob-like; 4b obscure. Right valve cardinal tooth 1 larger than 3b. No anterior lateral teeth. Posterior lateral teeth long, laminar, remote from the cardinals. Ligament external, opisthodetic, seated on short, prominent nymphs. Musculature and pallial features not observed. Ornament consisting of fine concentric ribs and growth lines.

Dimensions (mm):	Length	Anterior length	Height	Inflation
Holotype CPC9366	53	18	44	25 (internal mould)
Paratype CPC9369	60+	25	52	15 (1 valve)
Paratype CPC9368	52	19	41	22 (internal mould)

Remarks: *Fissilunula coreenaensis* sp. nov. may be distinguished from the Aptian species *F. clarkei* (Moore) by its smaller size and narrower, less elevated umbones. The species is common in silty sandstones of the Coreena Member.

Species of *Tancretella* superficially resemble *F. coreenaensis* but are more transversely elongated.

Occurrence:

Coreena Member: GAB1433; GAB2087; GAB2088; GAB2107.

Age: Early Albian.

Superfamily ARCTICACEA Newton, 1891

Family Neomiodontidae Casey, 1955

Remarks: Casey (1955) proposed this family for equivalve, inequilateral, subtriangular, ovate or suborbicular shells, with anterior to median, prosogyrous beaks. The valves are closed, sometimes carinate posteriorly, and have smooth internal margins. The hinge has well developed, undivided lucinoid cardinal teeth and corbiculoid, generally cross-striated laterals, the hinge formula being

$\dfrac{\mathrm{AI}\quad \mathrm{AIII}\quad 3a\quad 3b\quad (5b)\quad \mathrm{PI}\quad (\mathrm{PIII})}{(\mathrm{AO})\quad \mathrm{AII}\quad 2b\quad 4b\quad (\mathrm{PO})\quad \mathrm{PII}}$. The ligament is external, opisthodetic and is seated on nymphs, the adductor muscle scars are subequal and peripherally situated, the pallial line is simple or slightly sinuate, and the ornament is generally concentric.

Casey included the genera Neomiodon Fischer, Eomiodon Cox, Myrene Casey, Cyrenopsis Etheridge Jnr, and Musculopsis Mac Neil, and suggested that the family was probably the forerunner of the Corbiculidae and Sphaeriidae. He also noted (pp.209-211) that the Neomiodontidae shared features with the Astartacea on the one hand and with the Arcticacea on the other. This he thought, indicated that the family lay near the common root of those two superfamilies, a view subsequently endorsed by Hayami (1965b, p.128). Hayami (1965b) recognised two subfamilies, Eomiodontinae probably derived from species of Astartidae and Neomiodontinae possibly descended from primitive species of Arcticidae. In the former he placed Eomiodon Cox, Pseudasaphis Matsumoto, Protocyprina Vokes and Costocyrena Hayami; in the latter he included Neomiodon Fischer, Cyrenopsis Etheridge Jnr, Musculopsis Mac Neil, Myrene Casey and Crenotrapezium Hayami.

The Neomiodontidae first appeared in the Jurassic and became extinct in the Cretaceous. The habitat of the family was largely in brackish or freshwater.

Subfamily Neomiodontinae Casey, 1955

Remarks: This group is characterised by a more or less conspicuous posterior carina, the absence of a well defined lunule, the absence of the cardinal tooth 5b, a distinctly separated lateral PIII, a simple pallial line and concentric ornament. Differences between the Neomiodontidinae and the Eomiodontinae were tabulated by Hayami (1965b, p.132, table 1). He considered that the Neomiodontinae were probably derived from species of the early Jurassic arcticacean Eotrapezium Douvillé.

Genus Cyrenopsis Etheridge Jnr, 1902

Type species (by original designation): Mactra meeki (=Unicardium meeki Etheridge Jnr, 1892, Aptian, Great Artesian Basin.

Generic diagnosis: Subtrigonal, suborbicular, trigonal ovate or transversely ovate shells. Subequilateral to markedly inequilateral. Evenly inflated. Non-carinate. Umbones usually prominent, submedian to anterior. No lunule. Escutcheon long, rather deep. Hinge formula

$\dfrac{\text{AI AIII 3a 3b PI PIII}}{\text{AII 2b 4b PII}}$; 3a triangular; 3b slender, strongly opisthocline; 2b stoutly triangular; 4b slender, strongly opisthocline. Lateral teeth smooth; anterior laterals AI & AII swollen posteriorly. Ligament external, opisthodetic; seated on prominent nymphs. Pallial line simple. Exterior ornamented with very fine concentric growth lines and more prominent, regularly spaced depressions marking growth halts.

Range: ? Neocomian - Albian.

Remarks: The dentition is not visible on the type specimens of the type species of *Cyrenopsis*, *Mactra meeki* (=*Unicardium meeki*) Etheridge Jnr (1892, p.472, pl.27, figs 2-3). Because of this, Whitehouse (1925, p.32) stated that "the genus cannot be regarded as definitely established". Specimens identified below as *Cyrenopsis meeki* have essentially the same dentition as *Cyrenopsis opallites* Etheridge Jnr, and *Cyrenopsis balli* Day. Thus the writer concurs with Casey (1955, p.221) who considered that the salient features of the dentition were sufficiently known for the taxon to be recognised. However, the uncertainty concerning the hinge features of *Cyrenopsis meeki* can only be resolved by the description of the hinge from topotypes. At present suitable topotypic material is not available.

Casey (1955, p.221) gave the habitat of *Cyrenopsis* as "fresh or brackish water". However, species of *Cyrenopsis* are associated with normal marine faunas including ammonites and bivalves. *Cyrenopsis* is very common in initial deposits of transgressive seas, such as sandstones of the Minmi Member in the Roma-Mitchell area and basal sandstones of the Doncaster Member in the Tambo-Augathella area. Similarly, coquinas of

Cyrenopsis meeki near the top of the Doncaster Member in the Roma-Mitchell area and those of *C. hudlestoni* at the top of the Allaru Mudstone and near the base of the Mackunda Formation in the Augathella area testify to the proliferation of the genus in sediments deposited in the early stages of regression. Possibly, *Cyrenopsis* was a euryhaline genus peculiarly tolerant of brackish water conditions developed during initial phases of transgression and regression.

Seven species have been referred to *Cyrenopsis*. *Cyrenopsis meeki* (Etheridge Jnr, 1892), and *C. balli* Day (1967b) of Aptian age, and *C. hudlestoni* (Etheridge Jnr, 1892) of Albian age, are described below. The age of *C. corrugata* (Tate, 1898), *C. opallites* Etheridge Jnr (1902b) *C. australiensis* Newton (1915) and *C. elongata* Newton (1915), all described from White Cliffs, N.S.W., could be Aptian or Albian. Of these, *Cyrenopsis opallites* is the only species in which the hinge features are known. Reference of the remainder to *Cyrenopsis* must be considered tentative. In addition, there is an undescribed species of *Cyrenopsis* in Neocomian ? sediments of the Laura Basin.

At present there are no definite extra-Australian occurrences of the genus *Cyrenopsis*, although *Arctica limpidiana* McLearn (1933, pl.2, figs 3-5) refigured by McLearn (1945, pl.3, fig.12) and Jeletzky (1964, pl.24, figs 7-8) from the Albian Clearwater Formation of Alberta, Canada, is possibly congeneric.

Cyrenopsis meeki (Etheridge Jnr), 1892

Pl.41, figs 15-19; pl.42, figs 9-11

Synonymy:

1892 *Unicardium meeki* Etheridge Jnr, p.472, pl.27, figs 2-3.

1892 *Mactra meeki* Etheridge Jnr, pl.27, figs 2-3.

1892 Undetermined genus (? *Unicardium*) Etheridge Jnr, pl.26, figs 13-15.

1902a *Corbicula* ? *meeki* (Etheridge Jnr), p.30.

1902a *Cyrena* ? *meeki* (Etheridge Jnr), pl.6, figs 8-13.

1902b *Cyrenopsis meeki* (Etheridge Jnr), p.30.

1902 *Cyrenopsis meeki* (Etheridge Jnr); Etheridge Jnr and Dun, p.68.

1915 *Cyrenopsis meeki* (Etheridge Jnr); Newton, p.226, pl.6, figs 13-14.

1927 *Cyrenopsis meeki* (Etheridge Jnr); Whitehouse, p.146.

1960 *Cyrenopsis* cf. *meeki* (Etheridge Jnr); Day, p.311.

1964 *Cyrenopsis* cf. *C. meeki* (Etheridge Jnr); Day, table 3, p.18.

1966 *Cyrenopsis meeki* (Etheridge Jnr); Ludbrook, p.181, pl.25, figs 2-3.

1967b *Cyrenopsis* cf. *meeki* (Etheridge Jnr); Day, p.16, pl.3, figs 7-8.

Types: Lectotype: F1336 GSQ. Paralectotype F1337 GSQ.

Locality: Both specimens from "Walsh River", Blackdown Formation, upper Aptian.

Material: About 500 specimens preserved as internal and external moulds of separated valves.

Specific diagnosis: Subtriangular, subequilateral *Cyrenopsis* with gently arched dorsal margins.

Description: Small to medium sized (length 20-45mm). Thick shelled. Subtriangular; smaller specimens more transversely ovate than mature individuals. Equivalve; valves gently or strongly inflated. Subequilateral, posterior slightly produced. Valves closed, non-carinate. Dorsal margins gently arched, forming an angle of about 110^{o} at the umbones. Anterior and posterior margins bluntly rounded. Ventral margin gently convex. Umbones prominent, closer to the anterior. Beaks small, prosogyral. Lunule not defined. Escutcheon well impressed, lanceolate. Right valve with two cardinal teeth and two anterior and two posterior lateral teeth; 3a small, triangular, orthocline; 3b slender, strongly opisthocline; AI swollen posteriorly; AIII distinct from shell margin; PI and PIII long, smooth, laminar; PIII formed by shell margin. Left valve with two cardinal teeth and one anterior and one posterior lateral tooth; 2b stout, triangular, opisthocline; 4b slender, strongly opisthocline; AII and PII smooth, long and laminar. Ligament external, opisthodetic, seated on prominent nymphs. Adductor scars small, subequal ovate, elongated dorso-ventrally; well impressed. Pallial line simple. Ornament consisting of fine, very closely spaced, concentric growth lines and more prominent, regularly spaced, concentric depressions about 2-3mm apart near the centre of the valve.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Lectotype F1336 GSQ	42	-	37	28
Paralectotype F1337	37+	-	32	23
F30716 UQ	30	14	25	14
F30717 UQ	26+	13	24	17
F35529 UQ	30	14	26	9 (1 valve)
F35530 UQ	38	17	32	10 (")
F35556 UQ	22	10	-	6 (")
CPC9372	15	6	12	5 (")
CPC9373	15	-	-	6 (")
CPC9374	25	11	20	7 (")
CPC9375	25	11	22	7 (")
CPC9478	18+	-	17	7 (")

Remarks: Unfortunately, neither the lectotype (F1336 GSQ) nor the paralectotype (F1337 GSQ) from the "Walsh River" displays hinge features. Left valves from the Roma area now referred to *Cyrenopsis meeki* exhibit a dentition closely comparable to that of a left valve (F2392 GSQ) figured by

Etheridge Jnr (1892, pl.26, fig.14) from the "Upper Flinders River", and subsequently referred by him (1902b, p.30) to *Cyrenopsis meeki*. The dentition of right valves in the present collection is essentially similar to that of *Cyrenopsis opallites* figured by Etheridge Jnr (1902b, pl.5, fig.17). The same dentition is displayed by a right valve figured from South Australia by Ludbrook (1966, pl.25, fig.3) as *Cyrenopsis meeki*.

Cyrenopsis meeki (Etheridge Jnr) as now interpreted, is somewhat variable in shape and inflation. Smaller specimens tend to be more transversely ovate, have less prominent umbones and are less inflated than larger ones. The species forms coquinas near the top of the Doncaster Member in the Roma-Mitchell area.

Cyrenopsis balli Day (1967b, p.16, pl.3, figs 9-14, text fig.4) from the Minmi Member, is more transversely ovate and has anterior umbones.

Cyrenopsis opallites Etheridge Jnr (1902b, p.29, pl.5, figs 12-17) from White Cliffs in New South Wales is typically more orbicular in outline than *C. meeki*. Somewhat intermediate forms occur in basal sandstones of the Doncaster Member in the Tambo-Augathella area.

Another species from White Cliffs, *Cyrenopsis* ? *australiensis* Newton (1915, p.228, pl.6, figs 9-10) appears to be closely related to *C. meeki*, but is less inflated and has slightly more anterior umbones. The hinge of C. ? australiensis is not known.

The Albian species Cyrenopsis hudlestoni (Etheridge Jnr 1892, p.473, pl.28, fig.12) is less produced posteriorly and has steeply arched dorsal margins.

Occurrence:

Minmi Member: L141 GSQ ?; L143 GSQ; L144 GSQ ?; L150 GSQ.

Doncaster Member: "Upper Flinders River" (Etheridge Jnr, 1892); "Gammies Plains" (Whitehouse, 1927); RD5; RD83; RD87; RD90; RD91; RD92; RD111; RD116; RD122; RD124; RD194; RD243; L105 GSQ; L106 GSQ; L107 GSQ; L155 GSQ; GAB870; GAB884; GAB1036; GAB1831; GAB2098; GAB2102; GAB2115; GAB2117; GAB2152; GAB2162; SB105; SB112; SB129.

Coreena Member: GAB1933 (remanié fossil); SB103 ?

Blackdown Formation: "Walsh River" (Etheridge Jnr, 1892).

N.S.W.: "White Cliffs" (Newton, 1915).

Maree Formation: "L. Eyre Basin" (Etheridge Jnr 1902a) and several localities reported by Ludbrook (1966).

W. Aust.: "Melligo Sandstone" (Brunnschweiler, 1960).

Age: Early - late Aptian.

Cyrenopsis balli Day, 1967

Synonymy:

1927 Cyrenopsis sp. nov. Whitehouse, p.145.

1964 Cyrenopsis cf. C. meeki (Etheridge Jnr); Day, table 3 (pars.).

1967b Cyrenopsis balli Day, p.16, pl.3, figs 9-14, text fig.4.

Types: Holotype: F9161 GSQ. Locality: Damper Gully, 1 mile W. of Midcontinental Oil Well, Minmi Member, lower Aptian.

Paratypes: F9164 GSQ, F9171 GSQ, F9160 GSQ. Locality: F9160 GSQ, same locality as holotype; F9164 GSQ and F9171 GSQ, L143 GSQ, Minmi Member, lower Aptian.

Material: About 30 internal moulds of separated and closed valves, and a few specimens retaining shell.

Specific diagnosis: Transversely ovate, inequilateral Cyrenopsis with a markedly produced posterior.

Description: Thick shelled. Transversely ovate. Equivalve. Inequilateral. Posterior markedly produced. Dorsal margins gently arched. Anterior and posterior margins bluntly rounded. Ventral margins gently convex. Postero-ventral junction subangular. Umbones slightly anterior. Beaks prosogyral. Lunule not sharply defined. Escutcheon long and narrow. Hinge of right valve with two cardinal teeth; 3a stout, slightly opisthocline; 3b narrow, strongly opisthocline. Lateral teeth smooth; posterior laterals long and laminar; anterior laterals long, AI swollen posteriorly, AIII formed by the shell margin. Hinge of left valve not known. Ligament external, opisthodetic. Anterior adductor scars well impressed. Ornament of fine concentric growth lines, and weakly elevated, broadly spaced concentric ribs marking growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype F9161 GSQ	22	9	12	-
Paratype F9160 GSQ	20	9	12	-
" F9164 GSQ	38	17	25	18
" F9171 GSQ	38	c.16	25	16

Remarks: In outline *Cyrenopsis balli* resembles *C* ? *elongata* Newton (1915, p.229, pl.6, figs 17,18) from White Cliffs in N.S.W., but the latter has more anterior umbones and its hinge is not known.

Occurrence:

Minmi Member: "Red Hill" (Whitehouse, 1927); Damper Gully, 1 mile W. of Midcontinental Oil Well; L143 GSQ; L150 GSQ; SB124; SB227; SB228; SB232.

Age: Early Aptian.

Cyrenopsis hudlestoni (Etheridge Jnr), 1892

Pl.41, figs 11-14

Synonymy:

1892 Cytherea ? hudlestoni Etheridge Jnr, p.473, pl.28, fig.12.

1902b Cyprina ? hudlestoni Etheridge Jnr, p.30.

1902 Cytherea ? hudlestoni Etheridge Jnr; Etheridge Jnr and Dun, p.69.

1965 Cyrenopsis hudlestoni Etheridge Jnr; Day, p.420.

Type: Holotype: F1311 GSQ. Locality: "north-east end of Glanmire Block, seventeen miles south-west of Tambo", Allaru Mudstone or Mackunda Formation, lower upper Albian.

Material: About 200 specimens, mainly separated valves preserved as internal and external moulds.

Specific diagnosis: Subtriangular, subequilateral Cyrenopsis with steeply arched dorsal margins.

Description: Medium sized (length 20-25mm). Thick shelled. Subtriangular. Equivalve, well inflated. Subequilateral. Valves closed, non-carinate. Dorsal margins steeply arched, forming an angle of about 80° at the umbo. Anterior and posterior margins bluntly rounded, not produced. Ventral margin gently convex. Umbones prominent, slightly anterior. Beaks small, prosogyral. Lunule not defined. Escutcheon lanceolate. Right valve with two cardinal teeth and two anterior, and two posterior lateral teeth; 3a small, triangular, prosocline; 3b slender, strongly opisthocline; AI swollen posteriorly; PI long and laminar; AIII and PIII formed by shell margin. Left valve with two cardinal teeth and one anterior, and one posterior lateral tooth; 2b stout, triangular, slightly opisthocline; 4b slender, strongly opisthocline, AII and PII smooth, long and laminar. Ligament external, opisthodetic, seated on prominent nymphs. Anterior adductor scars small, subequal, well impressed. Pallial line simple. Ornament consisting of fine, very closely spaced concentric growth lines and more prominent, regularly spaced, concentric depressions about 2mm apart near the centre of the valve.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Holotype F1311 GSQ	25	11	23	10 (1 valve)
Topotype CPC9378	25	12	24	9 (")
Topotype CPC9379	22	9	19	6 (")
Topotype CPC9380	20	9	18	8 (")

Remarks: The holotype (F1311 GSQ), a left valve described by Etheridge Jnr (1892, p.473, pl.28, fig.12) from "north-east end of Glanmire Block, seventeen miles south-west of Tambo" does not show the hinge features. Etheridge Jnr (1902b, p.30) thought his species might be referrable to *Cyrenopsis*. Topotypic material reveals a typical *Cyrenopsis* dentition and thus confirms Etheridge Jnr's suggestion.

The almost equilateral shape and steeply arched dorsal margins of Cyrenopsis hudlestoni (Etheridge Jnr) are quite distinctive. The species is particularly abundant in the Tambo-Augathella area, where it forms coquinas in the upper part of Allaru Mudstone and the lower part of the Mackunda Formation.

Occurrence:

Allaru Mudstone: "north-east end of Glanmire Block, seventeen miles south-west of Tambo" ? (Etheridge Jnr, 1892); GAB1041; GAB1934; GAB1935; GAB2034?; GAB2048; GAB2050.

Mackunda Formation: GAB599; GAB653; GAB666?; GAB764; GAB822; GAB909?; GAB930?; GAB1301?; GAB1335?; GAB1360; GAB1368?; GAB2017; GAB2100; GAB2110.

Age: Early late Albian.

Order MYOIDA Stoliczka, 1870

Suborder MYINA Newell, 1965

Superfamily MYACEA Lamarck, 1818

Family Corbulidae Lamarck, 1818

Remarks: The family comprises rather small, triangular shaped, posteriorly rostrate shells that have closed, unequal valves, the right valve being larger and more inflated than the left valve. The ligament is partly internal and is housed in a chondrophore that is deep and prominent in the right valve and smaller and less conspicuous in the left valve. The hinge has one cardinal tooth in front of the chondrophore in the right valve and another behind the chondrophore of the left valve. Obscure lateral teeth are sometimes developed. The pallial line is simple or has a faint sinus and the ornament is usually concentric.

Representatives of the family are known from the Jurassic, but the group is not common until the Cretaceous. Living members are widely distributed, and include several freshwater forms.

Genus *Corbula* Bruguière, 1797

Type species (by subsequent designation, Schmidt, 1818): *Corbula sulcata* Lamarck, 1801, Recent, West African coast.

Generic diagnosis: Medium sized. Subtriangular. Rostrum with a sharp carina defined posteriorly by a deep sulcus. Umbones subcentral, capped by conspicuous nepionic valves of almost equal convexity. Adult valves markedly inequivalve; right valve much larger and more convex than the left valve. Adductor muscle scars suboval and subequal. Pallial line entire. Ornament on nepionic and adult valves consisting of coarse concentric costae, that are stronger on the right than on the left valve.

Range: Jurassic-Recent.

Remarks: The type species of *Corbula* is a comparatively large, coarsely ornamented form occurring in tropical seas off the west African coast. However, the genus has been broadly interpreted to include rather differently ornamented species ranging in age from Jurassic to Recent.

The generic identity of the rather delicately ornamented species "*Corbula*" *superconcha* Etheridge Jnr described below, is uncertain as the hinge features are not known.

"*Corbula*" *superconcha* Etheridge Jnr, 1907

Pl.42, fig.8

Synonymy:

1907 *Corbula superconcha* Etheridge Jnr, p.324.

Type: Lectotype: F10623 AM. Locality: "Sources of the Barcoo, Ward and Nive Rivers, south central Queensland", Coreena Member, lower Albian.

Material: About 20 separated valves retaining shell material, or preserved as internal and external moulds.

Specific diagnosis: Small, subtriangular and transversely elongate *Corbula*, with ornament consisting of fine concentric growth lamellae and fairly prominent concentric depressions marking growth halts.

Description: Small (length less than 20mm). Thick shelled. Strongly inflated umbonally. Left valve possibly smaller and less inflated than right valve. Subtriangular and transversely elongate. Rostrate posteriorly; rostrum bluntly carinate. Anterior and ventral margins evenly rounded. Postero-dorsal margin straight or slightly concave, sloping, meeting the ventral margin at mid-height. Umbones small, subcentral. Lunule wanting. Escutcheon weakly impressed. Hinge, ligament features and musculature not observed. Ornament consisting of fine concentric growth lamellae and fairly prominent concentric depressions marking growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Lectotype F10623 AM	17	-	14	4 (1 valve)
CPC9480	12	5	9	3 (")

Remarks: Etheridge Jnr (1907, p.324) described but did not illustrate this species. His material is still extant in the collections of the Australian Museum and the best preserved of his specimens (F10623 AM) is now selected as lectotype.

The present specimens have the same shape as Etheridge Jnr's types, but contribute little additional information on the species. No specimens with valves in apposition have been found and the extent of the inequality of the valves cannot be ascertained. Furthermore, the hinge and ligament features remain unknown.

"Corbula" superconcha Etheridge Jnr occurs in the lower part of the Coreena Member of the Tambo-Augathella area where it is a very minor constituent of coquinas composed largely of Barcoona *trigonalis* (Moore).

Tancredia (*Corburella*) aff. *trigoniformis* Day, which occurs in a coquina at the top of the Doncaster Member in this area, is larger but is very similar in outline to "*Corbula*" *superconcha*. The two are separated pending the discovery of specimens of the latter that show the hinge features and the inequality of the valves.

Corbula nanutarraensis Cox (1961, p.30, pl.6, fig.2) from the Lower Cretaceous Nanutarra Formation of Western Australia is more transversely elongated.

Occurrence:

Coreena Member: "Sources of the Barcoo, Ward, and Nive Rivers, South central Queensland" (Etheridge Jnr, 1907); GAB1936; GAB2039; GAB2041?; GAB2056; GAB2081; GAB2084.

Age: Early Albian.

Superfamily HIATELLACEA Gray, 1824

Family Hiatellidae Gray, 1824

Remarks: This Mesozoic to Recent family comprises widely gaping, concentrically wrinkled shells, which are more or less transversely elongated though frequently irregular in shape. They have strong external ligaments, weakly developed cardinal teeth, lack lateral teeth and possess shallow or deep pallial sinuses. Members of the family are adapted to a burrowing, nestling, or boring mode of life.

Genus *Panopea* Ménard de la Groye, 1807

Type species (by monotypy): *Panopea aldrovandi* Ménard de la Groye, 1807 (= *Mya glycymeris* Born, 1780), Recent, Mediterranean Sea.

Generic diagnosis: Usually very large. Equivalve. Oblong shaped, transversely elongated. Gaping anteriorly and posteriorly. Hinge with one prominent conical, cardinal tooth in each valve. Ligament external, conspicuous. Pallial sinus wide and deep. Ornament consisting of irregular concentric plicae and fine concentric growth lines.

Range: Jurassic-Recent.

Remarks: Most of the Jurassic and Cretaceous species of *Panopea* appear to belong to the subgenus *Myopsis* Agassiz. *Panopea s.s.* appears in the Upper Cretaceous, culminates in the Tertiary, and is represented today by about a dozen species occurring chiefly in cooler waters (Gardner, 1945).

Subgenus *Myopsis* Agassiz, 1840

Type species (by subsequent designation, Cox, 1946, p.31): *Mya mandibula* J. Sowerby, 1813, Aptian-Cenomanian, England.

Subgeneric diagnosis: Usually large. Oblong shaped. Inequilateral. Umbones anterior. Frontal gape slight or not developed.

Range: Jurassic-Cretaceous.

Remarks: Cox (1964, p.41) in selecting *Mya mandibula* J. Sowerby as type species of *Myopsis*, overlooked the fact that he had selected that species as type some 18 years previously (Cox, 1946, p.31).

Woods (1909) and Cox (1946) (1964) considered *Myopsis* a synonym of *Panopea*. Hayami (1966, p.153) has treated *Myopsis* as a subgenus of *Panopea* and this course is adopted herein. The most diagnostic character of the group is its poorly developed frontal gape.

The subgenus is commonest in the Cretaceous when its distribution was worldwide.

Panopea (Myopsis) maccoyi (Moore), 1870

Pl.43, figs 3-4

Synonymy:

1870 Mya maccoyi Moore; p.253, pl.13, fig.8.

1889 Myacites m'coyii (Moore); Tate, p.230.

1892 Glycimeris? maccoyi (Moore); Etheridge Jnr, p.480.

1892 Glycimeris sp. ind. Etheridge Jnr, pl.28, fig.6.

1901 Glycimeris maccoyi (Moore); Etheridge Jnr, p.30.

1902a Glycimeris maccoyi (Moore); Etheridge Jnr, p.38, pl.4, figs 10-11.

?1960 Genus ind. cf. Homomya Agassiz 1843; Brunnschweiler, p.33, pl.2, fig. 7, text fig. 27.

1964 Panopea rugosa Moore; Day, table 3 (pars).

1966 Panopea maccoyi (Moore); Ludbrook, p.170, pl.21, fig.3; pl.22, figs 1-3 only.

1967 Panopea sp. nov.? Skwarko, pl.3, figs 14-15 only.

1967b Panopea maccoyi (Moore); Day, p.25, pl.6, figs 1-3, text fig.5.

Type: Holotype: Lost. Locality: "between the Amby and Maranoa Rivers".

Neotype: (herein designated) F9232 GSQ, a large internal mould of a specimen with closed valves. Locality: "Head of Sawmill Ck, par.268, par. Barabanbel, N. of Amby", Doncaster Member, upper Aptian.

Material: About 20 closed valves, some retaining shell material and 10 internal and external moulds of separated valves.

Specific diagnosis: Large, well inflated Myopsis with no frontal gape:

length about 1.7 times height; markedly inequilateral; umbones broad, prominent, anterior; ornament of broad, irregularly spaced concentric plicae and fine concentric growth lines.

Description: Large (length 40-90mm). Thick shelled. Oblong shaped. Length about 1.7 times height. Equivalve. Markedly inequilateral. Well inflated; maximum inflation immediately in front of umbones. Anterior vertically truncate, closed. Posterior somewhat attenuated; vertically truncate; gaping widely. Ventral margins very gently convex. Dorsal margins long, almost straight. Umbones broad, prominent, situated in the anterior one-third of shell. Beaks contiguous, orthogyral. A variably developed carina extends from the antero-ventral junction toward the umbo. Lunule and escutcheon fairly well defined. Hinge with a single, conical cardinal tooth in each valve; that of the right placed anterior to that of the left. Ligament external, opisthodetic. Adductor muscle scars large, ovate, situated dorsally. Pallial sinus wide and deep, extending to mid-length. Ornament of broad irregularly spaced concentric plicae, and fine concentric growth lines.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Neotype	F9232 GSQ	88	30	52	47
	F1329 GSQ	62	26	38	10 (1 valve)
	F35514 UQ	55	20	32	7 (")
	F9174 GSQ	45+	22	34	26
	F9175 GSQ	45	14	30	22

Remarks: The holotype of this species, a left valve figured by Moore (1870, pl.13, fig.8) as Mya maccoyi was lost in the Garden Palace fire in Sydney in 1882 (Etheridge Jnr, 1892, p.xvi). The topotype (F9232 GSQ) now selected as neotype closely resembles Moore's type in size and appearance.

Etheridge Jnr (1901, p.30) and Ludbrook (1966, p.170-1) specifically separated the forms illustrated by Etheridge Snr (1872, pl.21, figs 2, 2a) as Panopea sulcata, and included that of figure 2 in P. maccoyi. However, Etheridge Snr's figures represent left and right valves of a single specimen. This specimen (F1253 QM), the holotype of Panopea sulcata, is too distorted to allow the characters of that species to be ascertained.

Panopea (Myopsis) maccoyi (Moore) is distinguished from Panopea moorei Day (= Panopaea rugosa Moore, 1870 non Keyerling 1846, nee d'Orbigny 1850) by its anterior umbones. Specimens somewhat intermediate between the two species occur in the Minmi Member.

Specimens found in place at right angles to the bedding seem to have been distorted by compaction. They display very prominent carinas extending from the umbo to the antero-ventral junction, and appear to have been shortened anteriorly. Specimens of Panopea sp. nov.? illustrated by Skwarko (1967, pl.3, figs 8-15) from the Gibson Desert also display this phenomenon. One of Skwarko's specimens (CPC6958) is a typical representative of P. (M.) maccoyi.

Panopea sp. cf. P. maccoyi (Moore) described by Skwarko (1966, p.114, pl.12, figs 10-12) does not appear to be closely related.

Panopea (Myopsis) maccoyi (Moore) resembles the English Lower Greensand species P. (M.) plicata J. Sowerby described by Woods (1909, p.222, pl.35, figs 9-14; pl.36, figs 1-8) as Panopea gurgitis Brongniart. Specimens of Panopea plicata described from the Lower Cretaceous of Japan by Hayami (1966, p.153, pl.22, figs 1-7) and from the Lower Cretaceous of the Caucasus and Crimea by Drushchitz and Kudryavtzeva (1960, p.219, pl.27, figs 10-12) are also similar. Some of the English and Japanese specimens display numerous, fine radial threads. These have not been detected on specimens of P. (M.) maccoyi.

The type species of Myopsis, Mya mandibula J. Sowerby, as figured by Woods (1909, pl.37, figs 1-5), is relatively higher, has narrower umbones and possesses a shallow furrow that extends from the umbo towards the postero-ventral junction.

Occurrence:

Minmi Member: "Minmi near Roma" (Etheridge Jnr, 1892); Clerk's Ck, 1 mile below the junction of Bindango Ck.; RD39; RD78; RD107; RD128; RD283; SB107; SB127; SB264.

Doncaster Member: "between the Amby and Maranoa Rivers" (Moore, 1870); head of Sawmill Ck, por. 268, par. Barabanbel, N. of Amby; L156 GSQ; GAB2098; GAB2166; SB116; SB120; BMR Richmond 1 (252' 7" - 252" 9½"; 277'7" - 277'8"); BMR Richmond 2 (241'8" - 241'8½").

Maree Formation: "L. Eyre Basin", "Springs along S. shore of L. Eyre" (Etheridge Jnr 1902a); and numerous localities reported by Ludbrook (1966).

W.A.: *Gibson Desert*: "Mt. Beadell (locality 22)" (Skwarko, 1967).

?*Melligo Sandstone*: "White Cliffs, N. of Fraser R." (Brunnschweiler, 1960).

Age: Early - late Aptian.

Panopea (*Myopsis*) *moorei* Day, 1967

Pl.43, figs 1-2; pl.44, figs 13-14

Synonymy:

1870 *Panopaea rugosa* Moore, p.253, pl.13, fig.7 (*non* Keyserling, 1846, *nec* d'Orbigny, 1850).

1884 *Myacites*? *australis* Hudleston, p.340, pl.11, fig.9.

1885 *Myacites*? *australis* Hudleston; Tate, p.75.

1889 *Myacites rugosa* (Moore); Tate, p.230.

1892 *Glycimeris rugosa* (Moore); Etheridge Jnr, p.478, pl.28, figs 4-5.

1901 *Glycimeris rugosa* (Moore); Etheridge Jnr, p.29, pl.4, fig.1.

1902a *Glycimeris rugosa* (Moore); Etheridge Jnr, p.38, pl.4, figs 8-9, ? 12.

1927 *Panopea rugosa* Moore; Whitehouse, p.146.

1957 *Prohyria eyrensis* (Etheridge Jnr); McMichael, pl.13, figs 9-10 only.

1960 *Panopea rugosa* Moore; Brunnschweiler, p.32, pl.2, figs 10-12, text figs 25-26.

1961 *Panope rugosa* Moore; Woods, p.3, p. 6.

1964 *Panopea rugosa* Moore; Day, table 3 (*pars.*).

1965 *Panopea rugosa* Moore; Day, p.418.

1966 *Panopea maccoyi* (Moore); Ludbrook, pl.22, figs 4-5 only.

1967b Panopea moorei Day, p.25, nom. nov. for Panopaea rugosa Moore, non Keyserling 1846 nec d'Orbigny, 1850.

Types: Panopaea rugosa Moore. Holotype: Lost. Locality: "Bungeeworgorai Ck, 20 miles SE of Mt Abundance", probably from Doncaster Member, upper Aptian. Neotype: (herein designated) F7837 GSQ, a specimen with both valves in apposition. Locality: RD87, Doncaster Member, upper Aptian.

Myacites? australis Hudleston. Lectotype and 2 paralectotypes: L9686 BMNH. Locality: "Mt Hamilton, 20 miles SW of L. Eyre or 40 miles SW of Peake", Maree Formation, Aptian.

Material: About 30 specimens with closed valves, mainly preserved as internal moulds.

Specific diagnosis: Large, well inflated Myopsis with no frontal gape; length about 1.5 times height; slightly inequilateral; umbones broad, prominent, situated just in front of mid-length; ornament of fine concentric growth lines and low, widely spaced concentric plicae.

Description: Large (length 50-90mm). Thick shelled. Oblong shaped. Length about 1.5 times height. Equivalve. Slightly inequilateral. Well inflated; maximum inflation immediately in front of the umbones. Anterior almost vertically truncate; closed. Posterior broadly rounded; gaping widely. Dorsal margins long, gently arched. Ventral margins gently convex. Umbones broad, prominent, situated just in front of mid-length. Beaks contiguous, slightly prosogyral. A faint carina extends from the anterior side of the umbo towards the antero-ventral junction. Lunule and escutcheon fairly well defined. Hinge with a single, high, conical, cardinal tooth in each valve; that of the right articulating in front of that of the left. Ligament external, opisthodetic. Adductor muscle scars large, oval, situated dorsally. Pallial line with a wide, very deep sinus extending to the line of the umbones. Ornament of fine concentric growth lines and low, widely spaced concentric plicae.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Neotype	F7837	82	37	52	37
	F9194	75	31	45	32
	L9686 BMNH	56	-	38	24
	L9686 BMNH	59	-	39	24.5
	L9686 BMNH	54	-	36	23

Remarks: The holotype of this species, a right valve poorly figured by Moore (1870, pl.13, fig.7), was lost by fire in Sydney in 1882 (Etheridge Jnr, 1892, p.xvi). The specimen (F7837) GSQ) now selected as neotype has both valves in apposition and closely resembles the species as interpreted and illustrated by Etheridge Jnr (1892, p.478, pl.28, figs 4,5). The locality cited for this species by Moore "Bungeeworgorai Ck, 20 miles SE from Mt Abundance" lies within Tertiary strata. Possibly Moore's type was from Bungeworgorai Ck, near Mt Abundance homestead, where the neotype was found.

The name Panopea rugosa Moore is pre-occupied by Keyserling (1846) and d'Orbigny (1850). Hudleston's Myacites? australis, if transferred to Panopea, is preoccupied by the recent southern

Australian Panopea australis Sowerby, 1833. Etheridge Jnr (1901, pp. 29-30) and Ludbrook (1966, pp. 170-171) considered that the right valve figured by Etheridge Snr (1872, pl.21, fig.2a) as Panopea sulcata, represented P. rugosa. However, they referred its opposing left valve (pl. 21, fig.2) to P. maccoyi (Moore). As noted in the remarks on P. maccoyi, the holotype of P. sulcata (F1253 QM) is too poorly preserved for the species to be recognisable. Thus P. sulcata cannot be considered an alternative name for P. rugosa. Day (1967b, p.25) renamed Moore's species Panopea moorei.

The specimen (M2436 GSSA) figured by Ludbrook (1966, pl.22, fig. 6) as Panopea sulcata may be conspecific with P. acuta Etheridge Snr (1872, pl.21, fig.3a only). The lectotype of Panopea acuta (F1251 QM) designated by Waterhouse (1965a,p.851) is probably from Maryborough, as its matrix agrees with that of specimens from Maryborough. As Waterhouse (1965a,p.852) observed the other specimen (F1252 QM) figured by Etheridge Snr (1872, pl.21, fig.3) as P. acuta is a Permian Vacunella, and probably is from Pelican Creek.

Ludbrook (1966, pl.22, figs 4-5) refigured as Panopea maccoyi the specimen (NMV P16764) erroneously included by McMichael (1957, pl.13, figs 9-10) in the Triassic freshwater species Prohyria eyrensis. However, the specimen has subcentral umbones and is a typical representative of Panopea moorei.

Panopea (Myopsis) moorei resembles P. (M.) maccoyi, but has subcentral umbones and is not as transversely elongated.

Occurrence:

Doncaster Member: "Bungeeworgorai Ck, 20 miles SE of Mt Abundance" (Moore 1870); "Maranoa River, half a mile above Mitchell Railway Station"; "Wollumbilla" (Etheridge Jnr, 1892); "Roma Downs homestead (por. 4)" (Whitehouse, 1927); RD87; RD90; RD92; RD121; RD122; RD222; L98 GSQ; SB129; GAB884; GAB1115; GAB1137; GAB1236; GAB1887; GAB2152; GAB2156.

Jones Valley Member: GAB1139; GAB1140.

Blackdown Formation: W8; W10; W35; W47; W50 (Woods, 1961).

Maree Formation: "Mt Hamilton, 20 miles SW of L. Eyre, or 40 miles SW of Peake" (Hudleston, 1884); "45 miles SW of Cootanoona Station, L. Eyre" (Etheridge Jnr, 1892); "L. Eyre Basin"; "Springs along S. shore of L. Eyre" (Etheridge Jnr, 1902a).

W. Aust.: Melligo Sandstone: "Stony Ridge, 2 miles S. of Broome - Derby Highway" (Brunnschweiler, 1960).

Age: Late Aptian.

Panopea (Myopsis) aramacensis (Etheridge Jnr), 1892

Pl.43, figs 5-8

Synonymy:

1892 Glycimeris aramacensis Etheridge Jnr, p.479, pl.28, figs 7-8.

1966 Panopea aramacensis (Etheridge Jnr); Ludbrook, p.169, pl.22. fig.7.

Type: Holotype: F1330 GSQ. Locality: 'Aramac', Coreena Member or Allaru Mudstone, lower or lower upper Albian.

Material: Seven specimens with closed valves and three with separated valves.

Specific diagnosis: Small to medium sized, weakly inflated *Myopsis* with a slight frontal gape; length almost twice height; ornament consisting of strong, broad, concentric plicae and fine concentric growth lines.

Description: Small to medium sized (length 20-60mm). Elongately oblong; length almost twice height. Equivalve. Inequilateral. Weakly inflated; maximum inflation immediately in front of umbones. Dorsal and ventral margins almost straight. Anterior vertically truncate; with a slight gape. Posterior somewhat attenuated; vertically truncate; gaping widely. Umbones broad, prominent; situated in the anterior third of shell. Beaks contiguous, orthogyral. A faint carina extends from the antero-ventral margin toward the umbo. Hinge, musculature and pallial features not observed. Ornament consisting of fine concentric growth lines, and strong, broad, concentric plicae which later diminish in strength.

Dimensions: (mm)		Length	Anterior length	Height	Inflation
Holotype	F1330 GSQ	37	13	20	13
	CPC9243	39	13	20	7
	CPC9365	56+	18	30	9

Remarks: *Panopea* (*Myopsis*) *aramacensis* (Etheridge Jnr) is closely related to the Aptian species *P.* (*M.*) *maccoyi*, but may be distinguished by its slight anterior gape, greater transverse elongation, weaker inflation and stronger concentric plicae.

Occurrence:

Ranmoor Member: GAB1144.

Allaru Mudstone: ?"Aramac" (Etheridge Jnr, 1892) GAB2053?; GAB2096.

Mackunda Formation: GAB624?; GAB812; GAB817; GAB1403.

Maree Formation: Maree 5/646/25; Toopawarinna 6/590/5 (Ludbrook, 1966).

Age: Early - early late Albian.

Subclass PTERIOMORPHIA Beurlen, 1944

Order ARCOIDA Stoliczka, 1871

Superfamily ARCACEA Lamarck, 1809

Family Cucullaeidae Stewart, 1930

Remarks: The problem of defining the limits of this rather variable family has been discussed by Nicol (1954). Its members are subquadrate to trapezoidal in shape, inequilateral, sometimes in equivalved with the left valve the larger, lack a byssal gape, and frequently have valves with differing radial ornament. The symmetrically arranged, prionodont teeth vary in size and number, and all except the living species have prominent chevron shaped ligament grooves.

The Cucullaeidae arose in the Lower Jurassic and flourished in the Upper Jurassic and Cretaceous, when the group was diverse in genera and species, and world wide in distribution. The family declined severely in the Tertiary and today the sole survivor, *Cucullaea labiata* (Solander), is confined to the Indo-West Pacific area (Nicol, 1950).

Genus Indogrammatodon Cox, 1937

Type species (by original designation); Cucullaea virgata J. de C. Sowerby, 1840, Upper Jurassic, India.

Generic diagnosis: Medium to large in size. Equivalve. Subquadrate to trapezoidal, with an obtuse posterior carina. Hinge teeth small and vertical beneath the umbo, becoming larger and radially disposed anteriorly and posteriorly. Extremities of hinge line with 3-4 horizontal teeth, the posterior the longer. Radial ornament strong, markedly dissimilar in each valve; the right valve with more, and sometimes weaker, radial ribs than the left.

Range: Liassic-Maestrichtian.

Remarks: Indogrammatodon was proposed by Cox (1937, p.195) as a sub-genus of Grammatodon Meek and Haydon. Chavan (1947, p.184) treated the taxon as a subgenus of Nanonavis Stewart, a course also adopted by Hayami (1965a, p.238). Indogrammatodon is virtually confined to the Indo-Pacific region. In view of this, and the disagreement concerning its relationships with the essentially Jurassic Grammatodon and the Cretaceous Nanonavis, it seems preferable to assign Indogrammatodon generic rank as Ichikawa and Maeda (1958a) have done.

Cox (1940, p.45) (1965, p.31) and Chavan (1947, p.184) referred Indogrammatodon to the family Parallelodontidae. However, as noted by Nicol (1954), its shape and lack of byssal gape suggest a more appropriate inclusion in the Cucullaeidae. Vokes (1967, p.141) also included Indogrammatodon in the Cucullaeidae.

Indogrammatodon robusta (Etheridge Snr), 1872

Pl.45, figs 9-10

Synonymy:

1872 Cucullaea robusta Etheridge Snr, p.340, pl.20, fig.1.

1872 Cucullaea costata Etheridge Snr, p.340, pl.20, fig.2.

1892 Cucullaea robusta Etheridge Snr; Etheridge Jnr, p.562, pl.26, figs 1-4.

1902a Idonearca ? robusta (Etheridge Snr); Etheridge Jnr, p.27, pl.4, figs 1-3.

1964 Cucullaea sp., Day, table 3.

1966 Cucullaea (Dicranodonta) robusta (Etheridge Snr); Ludbrook, p.149.

1966b Grammatodon (Indogrammatodon) robusta (Etheridge Snr); Fleming p.13, pl.5, figs 1-5; pl.6, figs 1-4.

Types: Cucullaea robusta Etheridge Snr. Holotype: F1242 QM.

Cucullaea costata Etheridge Snr. Holotype: F1243 QM. Locality: Both from "Maryborough", Maryborough Formation, Aptian.

Material: One well preserved left valve, one internal mould of a left valve, and fragmentary external moulds of right valves.

Specific diagnosis: Strongly inflated, subquadrate Indogrammatodon; radial ribbing of equal intensity in each valve, but with more ribs in the right valve than the left.

Description: Medium sized (length 30-50mm). Subquadrate. Equivalve. Inequilateral. Strongly inflated in the umbonal region. Valves closed. Very weakly carinate. Hinge line long and straight, forming the maximum shell length. Posterior almost vertically truncate and slightly sinuate. Other margins gently convex. Umbones high and broad, almost entirely anterior of mid-length. Hinge and ligament features obscure in this material. Ornament on anterior and central parts of the left valve consisting of 12 strong, primary radial ribs and rare, intercalated, faint secondary ribs; posterior with fine, closely spaced, somewhat imbricate growth lamellae; at least 3 periods of growth halts are evident.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
CPC9204	38	15	22	10 (1 valve)
F9197 GSQ	45	c.15	29	15 (")

Remarks: Fleming (1966b) has redescribed this species and his illustrations of the hinge confirm Cox's (1940) tentative reference of it to Indogrammatodon. Ludbrook (1966) referred I. robusta to Dicranodonta Woods, but the long lateral teeth of that genus are oblique, not parallel, to the hinge margin.

Specimens from the Eromanga and Surat Basins are slightly smaller than Etheridge Snr's (1872) types. Larger individuals such as those from Maryborough figured by Fleming (1966b) develop numerous tertiary and quaternary ribs as their size increases.

Etheridge Jnr (1892) compared this species with Cucullaea virgata J. Sowerby (the type species of Indogrammatodon). However, radial ribs of the right valve of I. virgata, while more numerous than those of the left, are finer and less prominent, and the costation is subdued. In I. robusta there is a discrepancy in number of ribs on each valve, but the relative strengths of the radial costation remain the same. This feature points to relationship with species of Nanonavis in which ornament is only slightly different on the two valves.

Occurrence:

Maryborough Formation: "Maryborough" (Etheridge Snr, 1872); "Corporation Quarry, Maryborough" (Etheridge Jnr, 1892).

Doncaster Member: GAB1036, L155 GSQ.

Jones Valley Member: GAB1139.

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a).

Age: Late Aptian.

Genus Nanonavis Stewart, 1930

Type species (by original designation): Grammatodon carinatus (Sowerby) Woods, 1899 (= Arca carinata Sowerby, 1813), Aptian - Cenomanian, England.

Generic diagnosis: Small to medium in size. Equivalve. Inequilateral. Elongately trapezoidal, with a prominent posterior carina. Hinge teeth curve outward from beneath the umbo; anterior teeth slightly oblique; posterior teeth long and parallel to the hinge line. Both valves with numerous, closely spaced, fine radial ribs.

Range: Neocomian - Maestrichtian.

Remarks: Nanonavis was established by Stewart (1930, p.68) as a subgenus of Parallelodon Meek and Worthen. Chavan (1947), Ichikawa and Maeda (1958a) and Hayami (1965a) assigned it generic rank and this view is favoured as it clarifies the evolutionary sequence. Nanonavis is in any case not closely related to Parallelodon, from which it differs in shape and lack of byssal gape. Nicol (1954) transferred Nanonavis from the Parallelodontidae to the Cucullaeidae and it is retained in the latter family by Vokes (1967).

From Indogrammatodon, Nanonavis differs in its smaller size, its more prominent carina, and its radial ornament which is finer, more closely spaced, and not markedly different on each valve. Some species included in Nanonavis have valves with slightly differing radial ornament. As noted by Hayami (1965a), the existence of these morphological intermediates suggests derivation of Nanonavis from an Indogrammatodon stock.

The genus is widely distributed in the Northern Hemisphere.

Nanonavis hendersoni (Etheridge Jnr), 1892

Pl.45, figs 1-8

Synonymy:

1892 Cucullaea hendersoni Etheridge Jnr, p.468, pl.26, figs 2,3.

Types: Lectotype: F1301 GSQ (specimen of pl.26, fig.2, called holotype by Ludbrook 1966, p.149). Paralectotype: F1302 GSQ (specimen of pl.26, fig.2). Locality: Both from "North-east end of Glanmire block, seventeen miles south-west of Tambo, "Allaru Mudstone or Mackunda Formation, lower upper Albian.

Material: About 50 internal and external moulds of both valves.

Specific diagnosis: Weakly carinate Nanonavis, with a slightly oblique posterior truncation, and numerous fine radial ribs.

Description: Small to medium sized (length 10-40mm). Elongately trapezoidal. Equivalve. Inequilateral. Valves closed. Strongly inflated. Posterior carina well defined in small individuals; less marked in larger ones. Hinge line long and straight, almost parallel to the ventral margin. Anterior margin gently convex. Posterior truncation slightly oblique. Umbones prominent, slightly in front of mid-length. Ligament amphidetic and duplivincular. Ligament grooves on cardinal area numerous, chevron-shaped; the anterior limbs of the chevrons occupying only part of the cardinal area in front of the beak; posterior limbs extending the length of the cardinal area behind the beak. Hinge with one or two vertical teeth beneath the beak; anterior hinge margin with four slightly oblique teeth; posterior with two long teeth parallel to the hinge margin and one short tooth diverging below. Adductor scars small, subequal, not buttressed. Pallial line with a very slight sinus. Radial ornament the same in both valves, consisting of numerous, closely spaced, fine radial ribs, which are not obviously differentiated into primary, secondary and higher orders except near the ventral margins of large specimens. Radial ribs on the anterior more elevated and more widely spaced than ribs on the posterior. Concentric ornament consisting of very fine, closely spaced, slightly imbricate, concentric lamellae, and a few prominent concentric depressions marking growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
F1301 GSQ	10	4	7	4
F1302 GSQ	16	6	12	5 (1 valve)
CPC9206	10	4	6	3 (")
CPC9207	16	5	11	5 (")
CPC9208	20	8	13	7 (")

Dimensions: (mm) (Ctd)	Length	Anterior length	Height	Inflation
CPC9209	27	11	18	8 (1 valve)
CPC9211	20	7	14	6 (")

Remarks: The types of Nanonavis hendersoni are small, exfoliated specimens which do not show the ornament clearly. The ornament is described herein from topotypic material in collections GAB1935 and GAB2100. Posterior truncation in the lectotype (F1301 GSQ) is not as oblique as it appears to be in the illustration of Etheridge Jnr (1892, pl.26, fig.2).

South Australian specimens figured by Ludbrook (1966, pl.14, figs 18-19) may, or may not be conspecific. In size they approach the largest known representatives of N. hendersoni, but are devoid of ornament.

Nanonavis carinata (Sowerby), the type species of Nanonavis, closely resembles N. hendersoni in shape, size and hinge features. However, N. hendersoni is not as sharply carinate, has finer radial ornament and is not as obliquely truncate posteriorly.

Grammatodon ? daintreei (lectotype herein designated F13708 AM) described by Etheridge Jnr (1907, p.322, pl.60, figs 7,8) from the "sources of the Barcoo, Ward and Nive Rivers, south central Queensland" has more anterior umbones than N. hendersoni and the posterior ornament is stronger than the anterior. It may even be generically distinct. No further specimens of G. ? daintreei appear to have been collected.

Occurrence:

Allaru Mudstone: ? "N.E. end of Glanmire Block, 17 miles S.W. of Tambo" (Etheridge Jnr, 1892); GAB1931; GAB1935; GAB2008; GAB2018; GAB2028; GAB2034; GAB2048; GAB2049; GAB2050; GAB2070; GAB2104.

Mackunda Formation: GAB619?; GAB653; GAB764; GAB815; GAB822; GAB823; GAB834; GAB850; GAB923; GAB1215; GAB2040; GAB2100.

Age: Early late Albian.

Order MYTILOIDA Ferussac, 1822

Superfamily MYTILACEA Rafinesque, 1815

Family Mytilidae Rafinesque, 1815

Remarks: Representatives of this family are characterized by obliquely elongated, sub-rhomboidal shaped shells, which have very anteriorly placed umbones, an essentially internal ligament, and are either edentulous or have small dysodont teeth.

There is a close correlation of the peculiar "mytiliform" shape and reduction of the anterior part of the body with the mode of life, attached by an antero-ventrally protruded byssus. This adaptation has produced mytiliform shapes not only in the Mytilidae, but also in such unrelated stocks as the actinodont Modiomorphidae and the heterodont families Myoconchidae and Dreissenidae. As Cox (1940) observed, the dentition and ligament afford the most satisfactory criteria for recognition of fossil representatives of the Mytilidae.

The Mytilidae have had a long geological history. According to Cox (1940) the earliest undoubted mytilid appeared in the Devonian.

However, a group with such basically simple shell morphology has few characters suitable for use as taxobases, and comparatively few genera and subgenera have been proposed for fossil representatives.

Genus Inoperna Conrad, 1875

(= Pharomytilus Rollier, 1914)

Type species (by subsequent designation, Stephenson, 1923, p.239): Inoperna carolinensis Conrad, 1875, Upper Cretaceous, U.S.A.

Generic diagnosis: Shell ensiform, narrow and elongated. Ventral margin almost parallel to the hinge line. Anterior margin projecting slightly beyond the umbones. Exterior with a diagonal ridge dividing the surface into dorsal and ventral areas. Dorsal area bearing fine growth lines and sometimes bifurcating plicae parallel to the posterior margin. Ventral area with fine growth lines only.

Range: Middle Jurassic - Upper Cretaceous.

Remarks: Cox (1940, p.71) regarded Inoperna as a subgenus of Modiolus, whereas Conrad (1875, p.5), Stephenson (1923, p.239), Wade (1926, p.53) and Popenoe (1937, p.382) assigned it generic rank. Since the group is a chronologically distinct one, the latter course is adopted here.

Inoperna ensiformis (Etheridge Jnr), 1902

Pl.44, figs 6-7

Synonymy:

1884 Gervillia angusta Hudleston, p.341, pl.11, fig.5, non Muenster, 1838

1885 Gervillia angustata Hudleston; Tate, p.75.

1889 _Gervilleia angusta_ Hudleston; Tate, p.230.

1902a _Gervillia angusta_ Hudleston; Etheridge Jnr, p.14.

1902a _Modiola ensiformis_ Etheridge Jnr, p.22, pl.3, figs 8-12.

1925 _Modiola angusta_ (Hudleston); Whitehouse, p.30.

1960 _Mytilus_ n.sp. Day, p.311.

1964 _Inoperna angusta_ (Hudleston); Day, table 3.

1966 _Modiolus (Inoperna) ensiformis_ (Etheridge Jnr); Ludbrook, p.166, pl.20, fig.3.

1967b _Inoperna ensiformis_ (Etheridge Jnr); Day, p.17, pl.3, figs 4-6.

Types: _Gervillia angusta_ Hudleston. Lectotype: L9696 BMNH (specimen figured by Hudleston, 1884, pl.11, fig.5). Locality: "Mt. Hamilton, 20 miles S.W. of L. Eyre or 40 miles S.W. of Peake", Maree Formation, Aptian. _Modiola ensiformis_ Etheridge Jnr. Lectotype: T1306 (specimen figured by Etheridge Jnr, 1902a, pl.3, fig.8). Paralectotypes: T1305 (specimen of pl.3, figs 9-10), T1303 (specimen of pl.3, figs 11-12). Locality: T1305, T1306 "Springs along south shore of L. Eyre"; T1303 "Davenport Springs, L. Eyre South." Ludbrook (1966, p.166), nominated "bed of Aimee Creek, 30 miles south west of the Peake" (approx. 5/601/1) the type locality of this species. All specimens from lower part of Maree Formation, Aptian.

Material: About 20 internal and external moulds of separated valves, and about 10 closed valves, some retaining shell.

Specific diagnosis: Ensiform _Inoperna_ of variable size; dorsal and ventral margins straight; carina prominent; angle of obliquity about 20°, dorsal surface with an ornament of simple, non-bifurcating plicae and fine growth lines; ventral surface with fine growth lines only.

Description: Size variable (length 10-60mm). Shape ensiform. Dorsal and ventral margins long, straight; gradually diverging posteriorly. Posterior margin rounded, making an angular junction with the ventral margin. Anterior margin bluntly rounded, projecting slightly beyond the small, flattened umbones. Valves markedly carinate. Angle of obliquity about 20°; greater in small specimens. Maximum convexity at mid-length. Hinge without teeth. Ligament area long and narrow, smooth. Anterior adductor scar small, situated at the anterior extremity. Posterior adductor muscle scar indistinct. Exterior surface dorsal to the carina ornamented with fine growth lines and simple, non-bifurcating plicae which parallel the posterior margin, become sharply angled on the carina, fade, and continue as fine growth lines paralleling the ventral margin.

*Dimensions: (mm)	Length	Hinge length	Height	Inflation	Angle of obliquity (in °)
T1306 AUGD	60	c.40	19	9	18
T1305 AUGD	62	42	17	10	17
T1303 AUGD	44	30	16	4(1valve)	18
F3160 GSQ	30	20	14	9	20
F30724 UQ	14+	-	10+	3.5	25
F35759 UQ	9	6	6	-	28
CPC9852	31	21	15	8(1 valve)	25

*Dimensions measured after the scheme in Dickins (1963, p.61, fig.9).

Remarks: Whitehouse (1925, p.30) concluded that Modiola ensiformis Etheridge Jnr (1902a) was a synonym of Gervillia angusta Hudleston (1884). However, Hudleston's name is preoccupied by Gervillia angusta Muenster (1838), the type species of Angustella Waagen (1907) so Etheridge's name stands.

Modiolus subsolenoides Hudleston (1890, p.242, pl.9, fig.8) from the "Lake Eyre district", is somewhat similar, but is less carinate, and lacks the prominent dorsal ornament of Inoperna ensiformis.

The simple, non-bifurcating dorsal plicae of I. ensiformis indicate affinities with Jurassic and early Cretaceous species. Of these, the European and Indian Bajocian - Callovian species I. plicatus (J. Sowerby) is quite similar, but the dorsal plicae fade before reaching the carina (Cox, 1940, pl.5, figs 13-14). Inoperna gillieroni (Pictet and Campiche) from the Valanginian of Europe, has comparable ribbing but the figure of Gillet (1924, p.22, text fig.8) shows a concave ventral margin quite unlike that of I. ensiformis.

Upper Cretaceous species such as Inoperna carolinensis Conrad, I. flagellifera (Forbes) and I. bellarugosa Popenoe, all have bifurcating dorsal ribs.

Occurrence:

Minmi Member: RD78; L318 UQ; L2162 UQ; L144 GSQ; L147 GSQ; L272 GSQ; SB203; SB227; SB264.

Doncaster Member: L97 GSQ; L108 GSQ; GAB2098; SB106; SB110; SB129.

Maree Formation: "Mt. Hamilton, 20 miles S.W. of L. Eyre or 40 miles S.W. of Peake" (Hudleston, 1884); "Springs along S. shore of L. Eyre"; "Davenport Springs, L. Eyre South" (Etheridge Jnr, 1902a) and a few localities reported by Ludbrook (1966).

Age: Early - late Aptian.

Genus *Eyrena* Ludbrook, 1966

Type species (by original designation): *Modiola linguloides* Hudleston, 1884, Aptian, Great Artesian Basin.

Generic diagnosis: Very thick shelled. Mytiliform. Strongly inflated. Dorsal and ventral margins long and straight, diverging widely. Posterior margin evenly rounded. Umbones prominent, anterior, inrolled and twisted ventrally. Carina weak or moderately developed. Anterior end of the hinge line bearing 2 small sub-umbonal denticles in the right valve and one in the left. Posterior end with a laminar tooth. Ligament area wide, extensively thickened. Ligament sub-external. Anterior adductor scar small, inserted on the antero-ventral extremity of the shell wall. Posterior adductor scar quadrate. Anterior pedal retractor scar situated just behind the umbones. Posterior retractor scar inserted in front of the posterior adductor scar. Exterior ornamented with concentric growth lines.

Range: Aptian - Albian.

Remarks: Ludbrook (1966, p.161) incorrectly interpreted the hinge features and her generic diagnosis is emended above. The genus possesses subumbonal teeth and a prominent laminar posterior tooth. I have not observed the "10 fine, small plate-like denticles on the posterior side", reported by Ludbrook.

The thick shell, extensively thickened ligament area, sub-external ligament (indicated by the ligament gape) and the laminar posterior tooth make Eyrena a very unusual mytilid. The laminar posterior tooth distinctly resembles the postero-lateral tooth of the carditacean family Myoconchidae Newell (1957). However, the two are not thought to be closely related. The mytiliform Myoconchidae have heterodont cardinal teeth and the anterior adductor and anterior pedal retractor are borne on a prominent myophoric buttress, whereas the subumbonal teeth and anterior musculature of Eyrena are "normal" for the Mytilidae. The posterior dentition and peculiar ligament features of Eyrena may be correlated with the development of a very thick shell. A powerful ligament to open the heavy valves and supplementary dentition to guide their closure would have been advantageous to the living animal.

Eyrena linguloides (Hudleston), 1884

Pl.44, figs 10-12

Synonymy:

1870 Mytilus inflatus Moore, p.252, pl.13, fig.4, non Costa, 1846, nec Mueller, 1847.

1884 Modiola linguloides Hudleston, p.341, pl.11, figs 6a-b.

1885 Modiola linguloides Hudleston; Tate, p.75.

1887 Modiola linguloides Hudleston; Tate, p.53.

1889 Mytilus inflatus Moore; Tate, p.230.

1890 Mytilus linguloides (Hudleston), p.245.

1892 Mytilus inflatus Moore; Etheridge Jnr, p.467, pl.25, fig.11.

1902a *Mytilus inflatus* Moore; Etheridge Jnr, p.18, pl.2, figs 12-21.

1902a *Modiola eyrensis* Etheridge Jnr, p.22, pl.2, figs 5-9.

1907 *Mytilus moorei* Cossmann, p.201, *nom. nov.* for *Mytilus inflatus* Moore.

1925 *Mytilus inflatus* Moore; Whitehouse, p.30.

1927 *Mytilus linguloides* (Hudleston); Finlay, p.525.

1927 *Modiola eyrensis* Etheridge Jnr; Whitehouse, p.145.

1964? *Modiolus eyrensis* Etheridge Jnr; Day, table 3.

1964 *Mytilus tenisonwoodsi* Etheridge Jnr; Day, table 3.

1966 *Eyrena linguloides* (Hudleston); Ludbrook, p.162, pl.19, figs 1-4, 13.

1967 *Eyrena primulafontensis* (Etheridge Jnr); Skwarko, p.18, text fig. 4, pl.2, figs 4-5 only.

1967 *Eyrena* sp. cf. *E. linguloides* (Hudleston); Skwarko, p.19, pl.2, figs 6-10.

1967b *Eyrena linguloides* (Hudleston); Day, p.18, pl.4, figs 6-13.

Types: *Modiola linguloides* Hudleston. *Lectotype*: L9699 BMNH (specimen figured by Hudleston, 1884, pl.11, figs 6a-b). *Locality*: "Mt Hamilton 20 miles S.W. of L. Eyre or 40 miles S.W. of the Peake." Ludbrook (1966, p.162) designated the type locality as "Mt. Hamilton, 5/644/4," Maree Formation, Aptian.

Mytilus inflatus Moore. *Holotype*: Lost. *Locality*: "Wollumbilla", Doncaster Member, upper Aptian.

Modiola eyrensis Etheridge Jnr. *Lectotype*: T1299 AUGD (specimen figured by Etheridge Jnr, 1902a, pl.5, figs 5,6,7),

Locality: "Beresford Springs, L. Eyre South", Maree Formation, Aptian.
Paralectotype: T1298 AUGD (specimen figured by Etheridge Jnr, 1902a, pl.2, figs 8,9). Locality: "Stuart's Creek, Central South Australia, Maree Formation, Aptian.

Material: About 100 closed and separated valves, some with shell material but most preserved as internal and external moulds.

Specific diagnosis: Very inflated Eyrena with long, straight, widely diverging dorsal and ventral margins; carina weak; angle of obliquity about 38°.

Description: Small to large in size (length 20-60mm). Thick shelled. Very inflated. Mytiliform in shape. Dorsal and ventral margins long, straight, diverging widely. Posterior margin evenly rounded. Umbones prominent, anterior, inrolled and twisted ventrally. Valves weakly carinate. Ventral slopes steep. Angle of obliquity about 38°. Hinge line thickened, with a comparatively wide ligament area extending the full length of the dorsal margin. No ligament attachment grooves. Ligament sub-external; closed specimens with a marked ligament gape. Anterior extremity of hinge bearing two small sub-umbonal denticles in the right valve, and one in the left. Posterior extremity with a laminar tooth ventral to the ligament area. Anterior adductor scar elongated along the antero-ventral margin, slightly buttressed. Anterior pedal retractor scar small, sub-circular, deeply impressed, situated immediately below the hinge line and a few mm behind the umbo. Posterior adductor and retractor scars obscure. Ornament of irregularly spaced, concentric ridges marking growth halts, and fine concentric growth lines.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Angle of Obliquity (in °)
T1299 AUGD	47	25	35	24	-
T1298 AUGD	38	22	30	20	-
F7863 GSQ	41	23	28	22	37
F7909 GSQ	41+	22	29+	10 (1 valve)	36
F7907 GSQ	54	29	30	12 (")	34
F35539 UQ	22	13	16	5 (")	38
F9236 GSQ	46+	c.24	26+	30	-
CPC9316	50	25	34	10 (")	38

Remarks: Finlay (1927, p.525) pointed out that the name *Modiola linguloides* Hudleston (1884), regarded by Tate (1889), Hudleston (1890) and Etheridge Jnr (1892) as a synonym of *Mytilus inflatus* Moore (1870), is the first available name for this species. The replacement name *Mytilus moorei* proposed for the preoccupied *M. inflatus* by Cossmann (1907, p.201) is not required.

During preliminary examination specimens from the Roma-Wallumbilla area were doubtfully referred to *Modiola eyrensis* Etheridge Jnr (1902a). The proportions of the internal moulds on which that species was based (T1298 AUGD & T1299 AUGD) are similar to those of *Eyrena linguloides*. Etheridge's species is thus interpreted as a synonym of the latter. This view was also adopted by Ludbrook (1966, p.162).

Internal moulds from the Minmi Member which were initially identified as *Mytilus tenisonwoodsi* Etheridge Jnr (1892) (= *Mytilus planus* Moore, 1870 *non* Eichwald *nec*. Kloden) are dorso-ventrally compressed. They are now regarded as distorted specimens of _Eyrena linguloides_.

Three of the specimens figured by Skwarko (1967, pl.2, figs 2 & 4 (CPC6935), fig.5 (CPC6936), text fig 4 (right hand specimen CPC6957)) from "Mount Samuel" (B6) in the Gibson Desert of central Western Australia, and identified with the Albian species _Eyrena primulafontensis_ are herein referred to _Eyrena linguloides_. The other two (CPC6934 & CPC6950) are referred to _E. tatei_. Skwarko (1967, pl.2, figs 6-10) also figured as _Eyrena_ sp. cf. _E. linguloides_, typical representatives of _Eyrena linguloides_ from three additional localities in the Gibson Desert.

Eyrena primulafontensis (Etheridge Jnr, 1902a, pl.2, figs 22-24) is similar to _E. linguloides_, though smaller, with a shorter hinge line.

Another related species, _Eyrena tatei_ (Etheridge Jnr, 1902a, pl.2, figs 10-11) has a more prominent carina and is not as expanded posteriorly as _E. linguloides_.

Occurrence:

Minmi Member: "R199, parish of Euthulla" (Whitehouse, 1927); RD78; RD107; RD283; RD285; L142 GSQ; L145 GSQ; L149 GSQ; L154 GSQ; L272 GSQ; SB264.

Doncaster Member: "Wollumbilla" (Moore, 1870); RD122; L99 GSQ; GAB1017; GAB1118; GAB2152; SB112; SB116; BMR Richmond 2 (224'9" - 224'11").

Maree Formation: "Mt. Hamilton 20 miles S.W. of L. Eyre or 40 miles

S.W. of the Peak" (Hudleston, 1884); "Beresford Springs" and "Stuart's Creek, central South Australia" (Etheridge Jnr, 1902a) and numerous localities listed by Ludbrook (1966).

W. Aust.: Gibson Desert (Skwarko, 1967).

Age: Early - late Aptian.

Eyrena tatei (Etheridge Jnr), 1902

Synonymy:

1902a *Modiola tatei* Etheridge Jnr, p.21, pl.2, figs 10-11.

1902b *Modiola tatei* Etheridge Jnr, p.24, pl.1, fig.11.

1964 *Modiolus tatei* Etheridge Jnr; Day, table 3.

1966 *Eyrena tatei* (Etheridge Jnr); Ludbrook, p.164, pl.19, figs 5-9.

1967 *Eyrena primulafontensis* (Etheridge Jnr); Skwarko, p.18, text fig.4; pl.2, figs 1 & 3 only.

1967b *Eyrena tatei* (Etheridge Jnr); Day, p.19, pl.3, figs 1-3.

Type: Holotype: T1289 AUGD. Locality: "Stuart's (formerly Cooper's) Creek, South Australia," Maree Formation, Aptian.

Material: Seven internal and external moulds of separated valves and one specimen with closed valves.

Specific diagnosis: Narrowly elongated *Eyrena* with moderate inflation and prominent carina; angle of obliquity about 30°.

Description: Size variable (length 20-50mm). Shape mytiliform, narrowly elongated. Moderately inflated; a maximum at mid-length; compressed posteriorly. Anterior lobe weakly developed. Hinge line long, straight; more than half length of shell. Posterior margin rounded ventrally, almost straight dorsally, meeting the hinge line at an angle of about 145°. Ventral margin slightly sinuate at mid-length. Umbones, small, well removed from the hinge line; twisted antero-ventrally. Carina prominent. Angle of obliquity about 30°. Hinge and ligament features obscure. Anterior adductor scar well impressed, elongated along the antero-ventral margin. Posterior adductor scar and pedal scars not observed. Ornament of irregularly spaced growth ridges and fine growth lines.

Dimensions:(mm)	Length	Hinge length	Height	Inflation	Angle of obliquity (in °)
Holotype T1289 AUGD	47	30	25	18	-
F30723 UQ	32	17.	18	5 (1 valve)	30
F35560 UQ	22	15	13	7 (")	32

Remarks: The present specimens differ from the holotype (T1289 AUGD) figured by Etheridge Jnr (1902a, pl.2, figs 10-11), only in their smaller size and slightly sinuate ventral margins.

Eyrena linguloides (Hudleston) and *E. primulafontensis* (Etheridge Jnr) are both less carinate and more expanded posteriorly than *E. tatei*.

Two of the specimens figured by Skwarko (1967, pl.2, figs 1 & 3; text fig.4 left hand specimen CPC6950) from "Mount Samuel" (B6) in the Gibson Desert of central Western Australia, and identified with the Albian species *Eyrena primulafontensis*, are herein referred to *E. tatei*. The remainder are conspecific with *E. linguloides*. Skwarko (1967, p.19) remarked that "some of them depart from their usual appearance, increasing in breadth like *E. linguloides*".

Occurrence:

Minmi Member: RD6; RD109; L318 UQ; SB264.

Maree Formation: "Stuart's (formerly Cooper's) Creek" (Etheridge Jnr, 1902a) and several localities reported by Ludbrook (1966).

N.S.W.: "White Cliffs Opal field" (Etheridge Jnr, 1902b).

W. Aust.: Gibson Desert (Skwarko, 1967).

Age: Early - late Aptian.

Genus *Modiolus* Lamarck, 1799

Type species (by tautonomy): *Mytilus modiolus* Linneaus, 1758, Recent, Northern Europe.

Generic diagnosis: Edentulous mytilids with the anterior usually extending beyond the umbo. Angle of obliquity seldom exceeding 45°. Ligament internal, underlain by a conspicuous ridge. Anterior adductor well developed. Exterior smooth or ornamented with concentric growth stages and growth lines.

Range: Devonian - Recent.

Remarks: As noted by Cox (1940) this species group does not lend itself to subdivision and there is little to distinguish Palaeozoic and Mesozoic representatives from Recent ones.

Modiolus sp.

Pl. 44, figs 8-9

Material: A single internal and external mould of left valve.

Description: Small (length 25mm). Mytiliform. Bluntly carinate; angle obliquity 30°. Umbones obscure in this material. Hinge line long and straight, about three-fifths of shell length. Ventral margin diverging; sinuate. Posterior margin rounded ventrally, almost straight dorsally, meeting the hinge line at an angle of about 140°. Well inflated; maximum inflation at mid-length. Ventral slope steep, slightly concave. Hinge apparently without sub-umbonal teeth. Ligament area narrow, internal; underlain by a low ridge extending almost the length of the hinge line, Anterior adductor scar small, situated on the anterior lobe. Posterior adductor scar obscure. Pallial line well impressed. Exterior ornamented with numerous closely spaced growth stages, equally developed dorsally and ventrally, and much finer growth lines.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Angle of obliquity
CPC9298	25	15	15	5 (1 valve)	30°

Remarks: This form appears to be congeneric with *Modiolus* Lamarck, but in a genus with such relatively featureless morphology, the specific identification of a single, nondescript specimen does not seem justified.

Modiolus ? *katherineus* Skwarko (1966, p.95, pl.5, fig.13) from the Mullaman Beds is somewhat similar. However, Skwarko's species is difficult to evaluate as it is based only on two external moulds and nothing is known of the hinge features.

Occurrence:

Nullawurt Member: SB230.

Age: Neocomian.

Genus *Falcimytilus* Cox, 1937

Type species (by original designation): *Mytilus suprajurensis* Cox, 1925, Upper Jurassic, England.

Generic diagnosis: Sickle-shaped mytilids, with pointed, terminal umbones, and a prominent carina. Sub-umbonal teeth absent. Ligament supported as in *Mytilus* *s.s.* by an internal ridge. Anterior adductor scar small, situated on the shell-wall in the umbonal angle. Exterior smooth.

Range: Jurassic.

Remarks: Cox (1937a, p.343) proposed *Falcimytilus* as a subgenus of *Mytilus*. However, the group is both morphologically and chronologically distinct and, like *Inoperna* Conrad, warrants generic rank. *Falcimytilus* differs from *Mytilus* *s.s.* in shape and in the absence of sub-umbonal teeth.

Falcimytilus ? *rugocostatus* (Moore), 1870

Pl.44, figs 1-5

Synonymy:

1870 *Mytilus rugocostatus* Moore, p.252, pl.13, fig.2.

1887 *Modiola scoulari* Tate, p.53.

1889 *Mytilus rugocostatus* Moore; Tate, p.230.

1890 *Mytilus* sp. Hudleston, p.245, pl.9, fig.9.

1892 *Mytilus rugocostatus* Moore; Etheridge Jnr, p.466.

1902a *Mytilus rugocostatus* Moore; Etheridge Jnr, p.20, pl.3, figs 1-7.

1925 *Modiola cupula* Whitehouse, p.30, pl.1, fig.4.

1927 *Modiola rugocostata* (Moore); Whitehouse, p.146.

1964 Mytilus rugocostatus Moore; Day, table 3.

1966 Modiolus rugocostatus (Moore); Ludbrook, p.164, pl.20, figs 1-2, 4-5.

Types: Mytilus rugocostatus Moore. Holotype: Lost. Locality: "Wollumbilla", Doncaster Member, upper Aptian. Neotype: (herein designated) F9213 GSQ. An external mould of a left valve with part of its opposing right valve. Locality: L156 GSQ, Doncaster Member upper Aptian.

Modiola scoulari Tate. Lectotype: (herein designated) T1343 AUGD. Locality: "Davenport and Humphrey Springs", Maree Formation, Aptian.

Modiola cupula Whitehouse. Holotype:GUGDS3503. Locality: "Peake Station", Maree Formation, Aptian.

Material: About 50 internal and external moulds of closed, partly opened, and separated valves, usually in clusters.

Specific diagnosis: Comparatively thick shelled; sickle-shaped; with strong concentric ribs developed between the carina and the hinge margin on the initial 15-20mm of shell. Posterior and ventral surfaces ornamented with fine, irregularly spaced, raised growth lamellae and growth lines.

Description: Medium to large (length 30-60mm). Comparatively thick shelled. Equivalve. Strongly inflated. Ventral slope very steep and concave. Outline somewhat sickle-shaped; pointed anteriorly; obliquely expanded posteriorly. Hinge long; gently curved; extending two-thirds of shell length. Ventral margin sinuate. Posterior margins rounded ventrally; almost straight dorsally; meeting the hinge line at an angle of about 150°. Umbones small, terminal. Beaks not inrolled. Carina prominent, curved. Anterior end of carina subtending an angle of approx. 25° at the hinge margin. Posterior end of carina inclined at approx. 45° to that margin. Hinge line without teeth. Ligament internal. Ligament area long; widening posteriorly; underlain by a low ridge which is marked off from the body of the shell by a linear depression. Anterior adductor scar small, situated on the wall of anterior lobe. Posterior adductor scar faint. Pallial line sometimes well impressed. Anterior pedal retractor scar situated just below the hinge line and immediately behind the umbones. Posterior and ventral exterior surfaces ornamented with fine, irregularly spaced, raised growth lamellae and growth lines. Initial 15-20mm of shell between the carina and hinge margin with strong, closely crowded ribs, which parallel the posterior margin, weaken on crossing the carina and continue as growth lines paralleling the ventral margin.

<u>Dimensions</u>: (mm)		Length	Hinge length	Height	Inflation	Angle of obliquity (in °)
Neotype	F9213 GSQ	45	28	21+	7 (1 valve)	45
	F9205 GSQ	60	40	32	10 (")	45
	F9206 GSQ	55	35	28	10 (")	45
	F9207 GSQ	46	30	27	8 (")	45
	CPC9299	35	22	15+	8 (")	42
	CPC9300	33	20	22	7 (")	50

Remarks: The holotype figured by Moore (1870, pl.13, fig.2) from "Wollumbilla" was destroyed by fire (Etheridge Jnr, 1892, p.xvi). As no suitable topotypic material has been collected the neotype (F9213 GSQ) now selected is from "Roma Downs" (L156 GSQ), a locality about 20 miles west of Moore's type locality, but approximately the same stratigraphic level.

"Mytilus" rugocostatus Moore has the shape and hinge features of the Jurassic genus Falcimytilus. However, the ornament of Falcimytilus is faint, whereas "M." rugocostatus has initially rugose dorsal ornament which approaches that of Inoperna. In view of this and the Cretaceous age of the Great Artesian Basin species, "M." rugocostatus is only tentatively referred to Falcimytilus.

Small specimens of Falcimytilus ? rugocostatus superficially resemble Inoperna ensiformis (Etheridge Jnr), but the former is falciform in shape and has a sinuate ventral margin.

A specimen (T1343 AUGD) described by Tate (1887, p.53) as Modiola scoulari, but not figured, is a typical representative of Falcimytilus ? rugocostatus.

Ludbrook (1966, p.165) regarded Modiola cupula Whitehouse (1925, pl.1, fig.4) as a synonym of M. rugocostatus. The writer concurs with this view. Specimens from "Roma Downs" (L156 GSQ) identified by Whitehouse (1927, p.146) as Modiola cupula and Modiola rugocostata are indistinguishable.

Occurrence:

Doncaster Member: "Wollumbilla" (Moore, 1870); "Bungeworgorai Ck"

(Etheridge Jnr, 1892); "Roma Downs homestead (Portion 4)" and "Roma Downs (Portion 9)" (Whitehouse, 1927); L156 GSQ; SB117; SB129; GAB1384; GAB2098.

Maree Formation: "Davenport and Humphrey Springs" (Tate, 1887); "Lake Eyre District" (Hudleston, 1890); "Mt. Hamilton, 20 miles S.W. of L. Eyre South"; "Beresford Springs, L. Eyre South" (Etheridge Jnr, 1902a); "Peake Station" (Whitehouse, 1925); and several additional localities reported by Ludbrook (1966).

Age: Late Aptian.

Order PTERIOIDA Newell, 1965

Suborder PTERIINA Newell, 1965

Superfamily PTERIACEA Broderip, 1839

Family Inoceramidae Zittel, 1881

Remarks: This large and diverse family encompasses forms that are usually equivalve and quadrate to mytiliform in shape, but may be gryphaeoid and strongly inequivalve. Individuals sometimes attain enormous size. The shell consists of two layers, a nacreous inner layer and a well developed outer prismatic layer, and may be thick or thin. The ligament is generally multivincular, although serial ligament pits are lacking in some forms. Ornament commonly consists of concentric ribs and plicae, but radial and tuberculate ornament is developed in certain genera.

In the majority of older works inoceramids were classified with the Pernidae (= Isognomonidae). Comparatively few authors adopted the nominal subfamily Inoceraminae Zittel (1881). Heinz (1932) thought the group was polyphyletic. He recognised a family Inoceramidae for genera related to the Pernidae (= Isognomonidae) and a family Sphenoceramidae for those forms derived from the Pinnidae. This innovation gained scant acceptance. Cox (1955) proposed that Zittel's family group name be placed on the official list of family group names in zoology, and this proposal was accepted by the International Commission on Zoological Nomenclature (opinion 473, 1957). More recently Eberzun (1960) and Vokes (1967) have accorded the group full family status. Their view is adopted here.

The Inoceramidae are of considerable value in the correlation of Jurassic and Cretaceous rocks and the family has been intensively studied. Sornay (1966) has contributed a useful summary of the voluminous literature on the family. Numerous genera of inoceramids have been proposed, especially by Heinz (1932), but only those based on the more aberrant species have gained general acceptance. Subdivision of the group has been based primarily on shape and exterior ornamentation. Kauffman (1965), in a short abstract, reported that the internal morphology provides a more natural basis for grouping inoceramids. Unfortunately, the full details of his study are as yet unpublished.

The oldest definite inoceramids are of Triassic age (Hayami, 1960). Periods of proliferation occurred in the Jurassic (Aalenian - Oxfordian) and in the Cretaceous (Albian - Maestrichtian) (Pergament, 1967). Inoceramids are ubiquitous in Boreal and

Temperate Cretaceous faunas of post-Aptian age. Several Upper Cretaceous species have a world wide, isochronous distribution. The family became extinct at the close of the Cretaceous.

Genus Inoceramus J. Sowerby, 1814

Type species (by subsequent designation I.C.Z.N. 473, 1957): *Inoceramus cuvierii* J. Sowerby, 1814, Upper Cretaceous, England.

Generic diagnosis: Shell of two layers, a nacreous inner layer and well developed prismatic outer layer. Equivalve except in aberrant species. Ovate, quadrate, rhomboidal, trapezoidalor mytiliform in outline. Height usually greater than length. Umbones more or less incurved, situated near the anterior extremity of the hinge line. Anterior ear usually rudimentary. Posterior ear variably developed. Ligament area narrow, or of moderate width, usually with numerous transverse ligament pits. Hinge usually edentulous, but sometimes with 1-2 oblique teeth in the antero-dorsal angle. Exterior ornamented with concentric and/or radial costae and/or plicae.

Range: Upper Triassic - Cretaceous.

Remarks: The proposals of Cox (1955) on the authorship and type species of the genus *Inoceramus* were embodied in opinion 473 of the International Commission on Zoological Nomenclature in 1957.

For the purposes of the present study the genus has been interpreted broadly, and the generic diagnosis of Inoceramus given above is essentially that of Cox (1940).

Inoceramus is quite rare in the Aptian Roma fauna but is exceedingly abundant and characteristic of the Albian Tambo fauna. Prismatic Inoceramus shell fragments locally form bioclastic limestones in the Toolebuc Limestone, Allaru Mudstone and Mackunda Formation.

Inoceramus cf. neocomiensis d'Orbigny, 1846

Pl.46, figs 9-10

Synonymy:

cf. 1911 Inoceramus neocomiensis d'Orbigny; Woods, p.262, pl.45, figs 1-2.

Material: One medium sized, partially exfoliated specimen with closed, slightly displaced valves and ten smaller specimens with separated valves.

Description: Small to medium sized (length 20-65mm). Erect; somewhat trapezoidal in shape; height exceeding length. Equivalve. Inequilateral. Small specimens weakly inflated. Larger specimens moderately inflated. Hinge line straight, short, one-third of shell length. Posterior ear small, obtusely rounded. Anterior margin concave near the umbones; gently convex and expanded ventrally.

Posterior and ventral margins broadly rounded. Umbones anterior, terminal, not elevated. Hinge features and musculature not observed. Ornament consisting of narrow, simple, widely spaced concentric costae. Small thin-shelled specimens have concentric costae impressed on internal moulds.

Dimensions: (mm)	Length*	Hinge length	Height*	Inflation	Anterior* angle
CPC9338	25	8	29	4 (1 valve)	110°
CPC9474	65	22	75+	40	115°

*Length measured here is greatest dimension parallel to hinge margin; height is greatest dimension at right angles to that margin; anterior angle is angle between hinge and anterior margins.

Remarks: The rather rare specimens from the Doncaster Member resemble those figured from the Lower Greensand of England by Woods (1911, pl.45, figs 1-2) as *Inoceramus neocomiensis*. However, the present material is insufficiently well preserved to be certain that the Australian and English forms are conspecific. According to Woods (1911, p.263) d'Orbigny's types are from the Barremian of Bettancourt, France. Casey (1961c, p.606) reported that *Inoceramus neocomiensis* ranged through the entire Aptian Lower Greensand (*deshayesi* - *nutfieldensis* Zones).

The shape of *Inoceramus* cf. *neocomiensis* is quite distinctive and readily distinguishes the form from the more commonly occurring Albian species of Inoceramus in the Tambo fauna.

Occurrence:

Doncaster Member: RD122; GAB2123; SB114; SB125; SB129.

Age: Late Aptian.

Inoceramus constrictus Etheridge Jnr, 1901

Pl.46, figs 1-8

Synonymy:

1901 Inoceramus constrictus Etheridge Jnr, p.24, pl.2, fig.7; pl.3, fig.6.

1928 Inoceramus pictus (J. Sowerby); Heinz, p.139 (pars.).

1928 Inoceramus constrictus Etheridge Jnr, Heinz, p.144.

1965 Inoceramus constrictus Etheridge Jnr; Day, p.419.

Types: Lectotype: F1316 GSQ (specimen figured by Etheridge Jnr, 1901, pl.3, fig.6). Paralectotype: F1317 GSQ (specimen figured by Etheridge Jnr, 1901, pl.2, fig.7). Locality: Lectotype, "Flinders River, Hughenden (behind Hughenden Hotel)", Ranmoor Member, lower or lower middle Albian; Paralectotype, "Marathon Station"?, probably from Ranmoor Member, lower or lower middle Albian.

Material: Fifteen separated valves and six specimens with partly opened valves.

Specific diagnosis: Inoceramus with a prominent anterior sulcus; outline rather quadrate, expanded postero-ventrally;

umbones narrow, weakly elevated; ornament consisting of more or less symmetrical, concentric plicae.

Description: Large or medium sized (length 30-110mm). Rather quadrate; expanded postero-ventrally. Thick shelled. Equivalve. Inequilateral. Well inflated about an antero-dorsal-postero-ventral axis; flattened postero-ventrally. Hinge line long and straight; about half shell length. Anterior margin gently convex, expanded beyond the line of the umbones. Postero-ventral margins broadly rounded. Posterior ear obtusely rounded. Umbones narrow, weakly elevated, situated at the anterior extremity of the hinge line. Beaks prosogyral, sharply pointed. Anterior with a broad sulcus extending from a point below the umbones to the antero-ventral margin; sulcus slightly deeper in the right valve. Hinge features and musculature not observed. Ornament consisting of more or less symmetrical concentric plicae. Plicae in early growth stages generally uniform in size, closely spaced; thicker, more prominent plicae occasionally developed. Plicae in later growth stages broader, less regular in size, and more widely spaced.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Anterior angle
F1316 GSQ	100+	c.50	100	25 (1 valve)	105°
F1317 GSQ	54	26	52	16 (")	110°
CPC9341	36	19	26+	10 (")	105°
CPC9342	34+	c.20	30	10 (")	-
CPC9339	36	17	32	10 (")	105°
CPC9340	47	23	42	12 (")	100°
CPC9294	110	-	80+	-	-

Remarks: The anterior sulcus of *Inoceramus constrictus* Etheridge Jnr, is very distinctive and has no counterpart among Australian species of the genus. The form is known only from the Ranmoor Member of the Hughenden area and Coreena Member of the Barcaldine area.

Inoceramus salomoni d'Orbigny described by Woods (1911, p.263, pl.45, figs 3-17) from the *mammilatum* Zone at Folkestone (earliest Albian) is closely allied to *I. constrictus*. The European species has a similar quadrate outline and an anterior sulcus, but the umbones are broader and more elevated. The close relationship existing between these species supports the early Albian age indicated by ammonites associated with *I. constrictus* in the Ranmoor Member.

Heinz (1928, p.144) previously noted that *I. constrictus* and *I. salomoni* were similar, but his concept of the former species differed from that of Etheridge Jnr which is adopted here. In _I. constrictus_ Heinz included only the specimen figured by Etheridge Jnr (1901, pl.2, fig.7) (now designated paralectotype). He thought the other (pl.3, fig.6) (now designated lectotype) was conspecific with _I. pictus_ J. Sowerby.

Occurrence:

Ranmoor Member: "Marathon Station ?" and "Flinders R., Hughenden, behind Hughenden Hotel" (Etheridge Jnr, 1901); GAB668; GAB1131; GAB1132; GAB1133; GAB1142.

Coreena Member: GAB1406?; GAB1408; GAB1437; GAB1704.

Age: Early Albian.

Inoceramus carsoni McCoy, 1865

Pl.47, figs 1-4

Synonymy:

1865 _Inoceramus carsoni_ McCoy, p.334.

1866 _Inoceramus carsoni_ McCoy, p.50.

1867c _Inoceramus carsoni_ McCoy, p.196.

1872 _Inoceramus pernoides_ Etheridge Snr, p.343, pl.22, fig.3. (_non_ Goldfuss, 1838).

1872 _Inoceramus multiplicatus_ Stoliczka var. _elongatus_ Etheridge Snr, p.343, pl.22, fig.2.

1892 _Inoceramus pernoides_ Etheridge Snr; Etheridge Jnr, p.464, pl.25, figs 7,8,12.

1892 *Inoceramus elongatus* Etheridge Snr; Etheridge Jnr, p.464.

1901 *Inoceramus etheridgei* Etheridge Jnr, p.22, *nom. nov.* for *Inoceramus pernoides* Etheridge Snr, 1872, *non* Goldfuss, 1838.

1905 *Inoceramus etheridgei* Etheridge Jnr, p.13, pl.2, figs 7-9).

1928 *Inoceramus pictus* (J. Sowerby); Heinz, p.139 (*pars*.).

1928 *Inoceramus carsoni* McCoy; Heinz, p.143.

1966 *Inoceramus carsoni* McCoy; Ludbrook, p.157, pl.17, figs 2-3.

Types: *Inoceramus carsoni* McCoy. Lectotype: P2172 NMV. Paralectotype: P2173 NMV (selected by Ludbrook, 1966, p.157). Locality: "West bank of Flinders River at the base of Walker's Table Mountains", probably from Allaru Mudstone, lower upper Albian.

Inoceramus pernoides Etheridge Snr. Holotype: F1238 QM. Locality: "Marathon Station", probably from Allaru Mudstone, lower upper Albian.

Inoceramus elongatus Etheridge Snr. Holotype: F1240 QM. Locality: "Marathon Station", probably from Allaru Mudstone, lower upper Albian.

Material: About 1,000 specimens with valves in apposition or separated, frequently retaining at least some shell material.

Specific diagnosis: Mytiliform shaped *Inoceramus* with an anterior angle of about 70°; beaks sharp, slightly incurved; ornamented with closely and regularly spaced, simple concentric plicae that fade at later growth stages, and fine occasionally bifurcating concentric costae.

Description: Usually small to medium sized (length 10-50mm); sometimes large (length 50-100mm). Thick shelled. Mytiliform. Equivalve. Inequilateral. Strongly inflated umbonally, flattened postero-ventrally. Length and height approximately equal. Hinge line short, gently curved, about one-third of shell length. Anterior margin slightly concave. Postero-ventral margin broadly rounded. Angle between hinge line and anterior margin 60-75°. Umbones narrow, terminal. Beaks sharp, slightly inrolled. Hinge with a series of high, narrow ligament pits. Ligament pits wider than interspaces. Musculature not observed. Ornament consisting of closely and regularly spaced, simple concentric plicae and fine, occasionally bifurcating concentric costae. Concentric plicae fade at larger growth stages. Much larger plicae developed at irregular intervals.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Anterior angle
P1272 NMV	70	25	54+	18 (1 valve)	70°
ANU17897	35+	15	50	15 (")	70°
ANU17896	82	c.25	84	23 (")	70°
ANU17898	65+	c.25	100+	25 (")	75°
CPC9210	40	15	45	16 (")	65°

Remarks: Etheridge Jnr (1901, p.22-23) considered that Inoceramus carsoni McCoy and I. sutherlandi McCoy were not validly proposed. Ludbrook (1966, p.157) concluded that McCoy's species, although not figured, were introduced with sufficient indication for these species to be recognized. The writer concurs with her view.

The present specimens correspond closely in shape and ornament to the lectotype (P1272 NMV) of Inoceramus carsoni designated and illustrated by Ludbrook (1966, pl.17, fig.3).

Inoceramus carsoni is exceedingly abundant in the Toolebuc Limestone and Allaru Mudstone, is somewhat rarer in the Mackunda Formation, and has a sparse representation in the upper part of the Ranmoor Member.

Specimens of Inoceramus sutherlandi McCoy (1865) are more quadrate than those of I. carsoni McCoy. However, the occasional occurrence of individuals of intermediate shape raises the possibility that the mytiliform I. carsoni and the quadrate I. sutherlandi are end members of only one very variable species. The two commonly occur in association.

"Inoceramus" jaunceyi sp. nov. from the Mackunda Formation resembles I. carsoni in shape but lacks plicate ornament.

Inoceramus etheridgei Etheridge Jnr (1901), herein regarded as a synonym of I. carsoni McCoy, is a senior homonym of Inoceramus etheridgei Woods (1911, p.278, pl.49, figs 2-4).

Occurrence:

Ranmoor Member: GAB1122; GAB1123; GAB1127.

Toolebuc Limestone: GAB661; GAB692; GAB752; GAB803; GAB945; GAB946A; GAB949; GAB951; GAB1002; GAB1005; GAB1014; GAB1926?; GAB2035?; GAB2036?; GAB2106?

Allaru Mudstone: ? "Flinders R. base of Walkers Table Mountain" (McCoy, 1865); ? "Marathon Station" (Etheridge Snr, 1872); "Flinders R. 3 miles above, 7 miles above, and 21 miles below, Richmond Downs Station"; "well at 200ft, 7 miles E. of Mt Cornish homestead?" (Etheridge Jnr, 1892); GAB821; GAB835; GAB836; GAB882; GAB1100; GAB1206?; GAB1222; GAB1225; GAB1230; GAB1231; GAB1394; GAB1416; GAB1603; GAB1610; GAB1770; GAB2007; GAB2025; GAB2026; GAB2027; GAB2053; GAB2063; GAB2070; GAB2096; BMR Longreach 4 (72' - 273'1").

Mackunda Formation: GAB834; GAB906; GAB923; GAB930; GAB1108; GAB1110; GAB1205?; GAB1224; GAB1301; GAB1309; GAB1311?; GAB1332; GAB1335?; GAB1336; GAB1609; Ju2.

Maree Formation: Numerous localities reported by Ludbrook (1966).

Age: Early - early late Albian.

Inoceramus sutherlandi McCoy, 1865

Pl.47, figs 5-6

Synonymy:

1865 Inoceramus sutherlandi McCoy, p.334.

1866 Inoceramus sutherlandi McCoy, p.50.

1867c Inoceramus sutherlandi McCoy, p.196.

1872 Inoceramus allied to I. problematicus d'Orbigny; Etheridge Snr, p.344, pl.22, fig.4.

1885 Inoceramus sp. Lundgren, p.4, pl.1.

1890 Inoceramus maximus Lumholz, p.367.

1892 Inoceramus sutherlandi McCoy; Etheridge Jnr, p.463.

1892 Inoceramus cripsii Mantell?; Etheridge Jnr, p.465, pl.21, figs 17-18.

1901 Inoceramus maximus Lumholz; Etheridge Jnr, p.24.

1924 Inoceramus maximus Lumholz; Whitehouse, p.128, pl.7, figs 1-2.

1928 Inoceramus maximus Lumholz; Heinz, p.141.

1928 Inoceramus sutherlandi McCoy; Heinz, p.143.

1966 Inoceramus sutherlandi McCoy; Ludbrook, p.157, pl.17, figs 1,4,6; pl.18, figs 1-2.

Types: Inoceramus sutherlandi McCoy. Holotype: P2170 NMV.

Locality: "W. bank of Flinders River, at the base of Walker's Table Mountains", probably from Allaru Mudstone, lower upper Albian.

Inoceramus maximus Lumholz. Holotype: University of Kristiania collection (Whitehouse, 1924). Locality: "Minnie Downs, near Tambo", Allaru Mudstone or Mackunda Formation, lower upper Albian.

Material: About 1,000 specimens with valves in apposition or separated, frequently retaining at least some shell material.

Specific diagnosis: Usually large, quadrate shaped *Inoceramus*, with an umbonal angle of about 90°; ornamented with closely and regularly spaced, simple concentric plicae which fade at later growth stages.

Description: Small to exceedingly large (length 10-500mm). Comparatively thick shelled. Inequilateral. Very slightly inequivalve. Left valve more convex than the right valve. Moderately inflated in the umbonal region; flattened postero-ventrally. Shape rather quadrate, expanded posteriorly. Hinge margin short, straight, about one-third of shell length. Anterior margin almost straight. Postero-ventral margin broadly rounded. Angle between hinge and anterior margins 85-100°. Posterior ear large, ill-defined, obtusely rounded. Umbones rather broad, terminal. Beaks sharp, slightly incurved. Hinge with a series high, narrow ligament pits. Ligament pits wider than interspaces. Musculature not observed. Initial ornament consisting of fine, simple, closely and regularly spaced, concentric plicae, that are symmetrical in section; much larger, stronger concentric plicae developed at irregular intervals. Later ornament subdued, consisting of concentric growth lines and broad, weakly elevated, widely spaced concentric folds. Umbonal region of internal moulds with fine radial costae.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Anterior angle
P2170 NMV	155+	-	170+	55 (approx.)	95°
CPC9238	180+	35+	230+	20 (1 valve)	100°
ANU17899	32	c.10	37	10 (")	95°

Remarks: The validity of McCoy's nominal species *Inoceramus sutherlandi* has been discussed above. The present specimens compare closely in shape with the holotype figured by Ludbrook (1966, pl.18, fig.1). Sometimes it is difficult to separate *Inoceramus carsoni* from *I. sutherlandi*. The possibility that the two are conspecific warrants closer investigation.

Inoceramus sutherlandi has a sparse representation in the upper part of the Ranmoor Member, but becomes exceedingly abundant in the younger Albian formations (Toolebuc Limestone, Allaru Mudstone, and Mackunda Formation). The species evidently obtained an enormous size as fragments of the postero-ventral region exceed 300mm in length.

Inoceramus maximus Lumholz, which was refigured by Whitehouse (1924, pl.7, figs 1-2), is considered to be conspecific with *I. sutherlandi*. Whitehouse (1924, p.131) compared *I. maximus* with the worldwide Cenomanian - Turonian species I. labiatus Schlotheim. Their close correspondence in shape led Heinz (1928, p.146) to assign I. sutherlandi a Cenomanian - Turonian age. However, ammonites associated with I. sutherlandi indicate an early - early late Albian age for this species.

Inoceramus flavus Sornay (1965, p.5, pl.A, figs 1-2, text fig.2) from the Cenomanian of Madagascar is also superficially similar in shape.

Occurrence:

Ranmoor Member: GAB1121; GAB1122; GAB1123.

Toolebuc Limestone: GAB685?; GAB801?; GAB945; GAB949.

Allaru Mudstone: "W. bank of Flinders R. at the base of Walker's Table Mountains" ? (McCoy, 1865); "Marathon Station", "Flinders River 3 miles above, and 13½ miles below, Richmond Downs Station"; "Muttaburra bore?"; "Aramac well at 238ft and 244ft?" (Etheridge Jnr, 1892); "Minnie Downs near Tambo" (Whitehouse, 1924); GAB802; GAB836; GAB854; GAB882; GAB1100; GAB1102; GAB1114; GAB1222; GAB1228; GAB1394; GAB2028; GAB2049; GAB2053; GAB2063; GAB2070; GAB2096; GAB2109; BMR Longreach 4 (136'4" - 201'9").

Mackunda Formation: GAB672; GAB767; GAB814?; GAB907; GAB913?; GAB1219; GAB1229; GAB1301; GAB1309; GAB1311; GAB1318?; GAB1335; GAB2071; GAB2110; Ju3.

Maree Formation: Several localities reported by Ludbrook (1966).

Age: Early - early late Albian.

Inoceramus marathonensis Etheridge Snr, 1872

Pl.47, figs 7-8

Synonymy:

1872 Inoceramus marathonensis Etheridge Snr, p.343, pl.22, fig.1.

1884 Inoceramus marathonensis Etheridge Snr; Etheridge Jnr, p.89, 1st pl., upper fig.

1892 Inoceramus marathonensis Etheridge Snr; Etheridge Jnr, p.464.

1892 Inoceramus sp. ind. Etheridge Jnr, pl.21, fig.19.

1928 Inoceramus marathonensis Etheridge Snr; Heinz, p.141.

Type: Holotype: F1239 QM. Locality: "Marathon", probably from Allaru Mudstone, lower upper Albian.

Material: About 10 separated valves, most of which are incomplete.

Specific diagnosis: Erect, postero-ventrally expanded Inoceramus; ornament consisting of coarse, irregularly spaced, asymmetric concentric plicae with much finer concentric costae in the interspaces; ornament obsolete in later growth stages.

Description: Medium sized (length 50-60mm). Thick shelled. Equivalve. Inequilateral. Erect; expanded postero-ventrally. Height considerably greater than length. Well inflated about mid-line. Hinge line straight, short. Anterior and posterior margins almost straight. Ventral margin broadly rounded. Posterior ear small. Umbones small, terminal. Beaks sharp.

Hinge features and musculature not observed. Ornament as per specific diagnosis.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Umbonal angle
F1239 QM	66	-	75+	15 (1 valve)	-
CPC9237	56	10+	80	12	90^{o}

Remarks: Inoceramus marathonensis Etheridge Snr (1872, p.343, pl.22, fig.1) is readily distinguished from other Australian species by its erect outline and asymmetric, coarse, plicate ornament. The left valve which constitutes the holotype (F1239 QM) was incomplete ventrally when Etheridge Snr described it. The holotype refigured here and is now also incomplete umbonally.

Occurrence:

Toolebuc Limestone: GAB946A?; GAB1005.

Allaru Mudstone: "Marathon" (Etheridge Snr, 1872); GAB2018; GAB2049; GAB2105; BMR Longreach 4 (79'5" - 292'9½"); Exoil Brookwood No.1 (Core 3 1480' - 1500'); A.A.O. Penrith No.1 (Core 2 1040'-1050'; Core 3 1600'-1610').

Mackunda Formation: "Landsborough Ck, Thomson River?" (Etheridge Jnr, 1884); GAB817?; GAB1108?

Age: Early late Albian.

Inoceramus procerus Whitehouse, 1924

Pl.45, fig.15

Synonymy:

1924 *Inoceramus procerus* Whitehouse, p.130, pl.6, fig.6.

1928 *Inoceramus maximus* Lumholz var. *procera* Whitehouse;
Heinz, p.145.

Type: Holotype: Specimen figured by Whitehouse (1924, pl.6, fig.4), University of Kristiania or University of Lund collection. Locality: "Minnie Downs near Tambo", Allaru Mudstone or Mackunda Formation, lower upper Albian.

Material: About 20 specimens with valves in apposition or separated, frequently retaining at least some shell material.

Specific diagnosis: Erectly ovate *Inoceramus*; slightly inequivalve; left valve more inflated than the right; ornament consisting of sharp, closely spaced, concentric plicae which occasionally bifurcate; ornament fading in later growth stages.

Description: Small to large (length 20-120mm). Thin shelled. Inequilateral. Erectly ovate; height considerably greater than length. Moderately expanded postero-ventrally; little expanded antero-ventrally. Slightly inequivalve; left valve more inflated than the right. Umbonal regions strongly inflated. Hinge line long and straight, about half shell length. Anterior and posterior margins gently convex. Ventral margin broadly rounded. Posterior ear large, flattened, frequently incomplete dorsally. Umbones prominent, narrow, terminal. Left valve umbo larger than that of right valve. Beaks sharp, slightly incurved. Hinge features and musculature not observed. Ornament as per specific diagnosis.

Dimensions:	Length	Hinge length	Height	Inflation	Anterior angle
Holotype*	116+	60	190+	-	100°
CPC9475	52	25	75+	15 (1 valve)	95°

*Dimensions measured from figure of Whitehouse (1924, pl.6, fig.4).

Remarks: *Inoceramus procerus* Whitehouse (1924) is a comparatively rare species and is common only in the Mackunda Formation of the Tambo-Augathella area. There, it is associated with an allied form, *I. scutulatus* Whitehouse (1924), which is more expanded in the antero-ventral region. Whitehouse (1924, p.131) considered *I. scutulatus* a possible ancestor of *I. procerus*, but this is not possible as the latter is the older.

The long ranging, widely distributed, quadrate shaped species *I. sutherlandi* McCoy is also related, but seems closer to *I. scutulatus*.

Inoceramus marathonensis Etheridge Snr (1872) approaches *I. procerus* in shape, but has more widely spaced, coarse concentric plicae.

Smaller specimens of the worldwide Albian species *Inoceramus concentricus* Parkinson described by Woods (1911, p.265, pl.15, fig.11; pl.16, figs 1-10; pl.17, figs 1-2) from the English Gault, closely resemble specimens of *I. procerus* Whitehouse of comparable size. Larger specimens of *I. concentricus* have more incurved umbones.

Occurrence:

Allaru Mudstone: GAB769; GAB802; GAB854; GAB1085; GAB1935?; GAB2028; GAB2034?; GAB2048; GAB2049; GAB2104.

Mackunda Formation: "Minnie Downs near Tambo?" (Whitehouse, 1924); GAB667?; GAB904?; GAB909; GAB1107?; GAB1328; GAB2071; GAB2100; GAB2110.

Age: Early late Albian.

Inoceramus scutulatus Whitehouse, 1924

Pl.45, fig.11

Synonymy:

1924 *Inoceramus scutulatus* Whitehouse, p.129, pl.5, figs 1-2; pl.6, figs 1-3.

1928 *Inoceramus maximus* Lumholz var. *scutulata* Whitehouse; Heinz, p.143.

Type: Holotype: Specimen figured by Whitehouse (1924, pl.5, fig.1; pl.6, fig.1), University of Kristiania collection.

Locality: "Minnie Downs near Tambo", probably from Mackunda Formation, lower upper Albian.

Material: About 20 specimens with valves in apposition or separated, frequently retaining shell material.

Specific diagnosis: Rather rhomboidal shaped, sub-equilateral *Inoceramus*; strongly expanded antero-ventrally; hinge line very short; ornament consisting of fine, simple, closely spaced concentric plicae, which fade in later growth stages.

Description: Medium to large (length 40-100mm). Thin shelled. Equivalve. Subequilateral. Rather rhomboidal shaped; height greater than length. Antero-ventral region strongly expanded, only slightly smaller than postero-ventral region. Moderately inflated umbonally. Hinge line straight, very short, about one-quarter of shell length. Ventral margin broadly rounded. Anterior and posterior margins almost straight. Hinge and anterior margins forming an angle of 110-120°. Posterior ear small, obtusely rounded. Umbones terminal, narrow, prominent, rising above hinge line. Beaks sharp, prosogyral. Hinge features and musculature not observed. Ornament as per specific diagnosis.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Anterior angle
Holotype*	90	24	110	40	120°
CPC9343	68	16	82	12 (1 valve)	110°

*Dimensions measured from figures of Whitehouse (1924, pl.5, fig.1; pl.6, fig.1).

Remarks: Whitehouse (1924, p.131) compared *Inoceramus scutulatus* with *I. crippsi* var. *reachensis* Etheridge Snr described by Woods (1911, p.278, pl.48, fig.5; pl.49, fig.1) from the Cenomanian of England. The two species are quite similar.

Whitehouse also observed that the closest Australian allies of this species were I. procerus Whitehouse and I. maximus Lumholz (= I. sutherlandi McCoy). The former is less produced antero-ventrally, while the latter has a longer hinge line and the angle between the hinge and anterior margins is smaller.

Inoceramus (Platyceramus) collignoni Sornay (1964, pl.1, figs 1-3) from the Senonian of Madagascar, which was compared with I. scutulatus by its author, has a longer hinge line than the Australian species.

To date Inoceramus scutulatus has been found only in the Mackunda Formation of the south-eastern Eromanga Basin.

Occurrence:

Mackunda Formation: "Minnie Downs near Tambo" (Whitehouse, 1924); GAB2071; GAB2100; GAB2110; Ju2.

Age: Early late Albian.

"Inoceramus" jaunceyi* sp. nov.

Pl.45, figs 12-14

*Named after Mr W. Jauncey, formerly of the Bureau of Mineral Resources, who collected the holotype.

Types: Holotype: CPC9477, an internal mould of a medium sized left valve. Paratypes: CPC9479, an internal mould of a small left valve; CPC9476, an internal mould of a medium sized right valve. Locality: Holotype, GAB764; Paratypes, GAB671, Mackunda Formation, lower upper Albian.

Material: About 50 specimens preserved mainly as internal moulds.

Specific diagnosis: Mytiliform, with a single, narrow, transversely elongated ligament pit; pallial line more-or-less continuous; ornament consisting of weakly elevated, widely spaced concentric folds that are usually not impressed on internal moulds.

Description: Small to large (length 20-80mm). Thin shelled. Inequilateral. Equivalve. Weakly inflated. Mytiliform. Length usually greater than height. Hinge margin slightly curved, about one-third shell length. Postero-dorsal margin very gently convex. Anterior margin more or less straight. Posterior bluntly rounded. Angle between hinge and anterior margins about 60-70°. Umbones narrow, terminal. Beaks sharp, prosogyral. Hinge line thickened, with a single, narrow, transversely elongated ligament pit. Pallial line more-or-less entire. Other musculature obscure. Ornament as per specific diagnosis.

Dimensions: (mm)	Length	Hinge length	Height	Inflation	Anterior angle
CPC9477	75	20	60	12 (1 valve)	65°
CPC9479	20	6	16	4 (")	60°
CPC9476	45	16	50	10 (")	70°

Remarks: The generic identity of "Inoceramus" jaunceyi sp. nov. is uncertain. The species has the well developed prismatic outer ostracum of Inoceramus, but the ligament features are more mytilid than inoceramid.

In outline "Inoceramus" jaunceyi sp. nov. resembles I. carsoni McCoy. However the ornament and ligament features of the two species is distinctly different. Internal moulds of "I." jaunceyi sp. nov. are almost smooth and quite unlike those of I. carsoni which are markedly plicate.

"Inoceramus" jaunceyi sp. nov. appears to be confined to the Mackunda Formation of the Northern Eromanga Basin.

Mackunda Formation Occurrence: GAB666; GAB671; GAB764; GAB767; GAB805; GAB813; GAB816?; GAB850; GAB851; GAB853; GAB903; GAB917; GAB1104?; GAB1105; GAB1106; GAB1112; GAB1215; GAB1250; GAB1301; GAB1309; GAB1318?; GAB1360?; GAB1609.

Age: Early late Albian.

Superfamily PECTINACEA Rafinesque, 1815

Family Pectinidae Rafinesque, 1815

Remarks: This family comprises the familiar, fan-shaped, auriculate, inequivalve scallop shells. A byssal notch is found in all genera in the juvenile stage, but may become obsolete in adults. The hinge usually has auricular or cardinal crura and the ligament is internal and housed in a triangular pit. The shells may be almost smooth or ornamented with radial and concentric plicae and/or ribs.

Numerous pectinid genera have been erected and several subdivisions of the family Pectinidae proposed (Korobkov, 1960) (Vokes, 1967). However, many genera are in need of revision and the validity of the several subfamilies awaits confirmation. The writer follows Newell (1965) in recognising only a single family Pectinidae. According to Korobkov (1960) the range of the family is Carboniferous to Recent.

Genus Camptonectes Agassiz in Meek, 1864

Type species (by original designation): Pecten auritus Schlotheim 1813 (=Pecten lens J. Sowerby, 1818), Middle and Upper Jurassic, England and Europe.

Generic diagnosis: Shell comparatively thick. Small to large. Suborbicular. Inequivalve. Weakly inflated; left valve more convex than the right. Ears unequal. Anterior ear of right valve with a wide fasciole. Byssal notch deep, with a well developed ctenolium. Hinge with variably developed cardinal crura. Exterior ornamented with fine, frequently punctate, radial costae, divergent from mid-line, and fine concentric growth lamellae.

Range: Jurassic - Cretaceous.

Remarks: Camptonectes closely resembles Micronectes Ichikawa and Maeda (1958b). According to these authors

(1958b, p.96) *Micronectes* differs in having well developed cardinal crura and microscopic, discontinuous, radial striations instead of the macroscopic, often punctate radial costae of *Camptonectes*. Speden (1967, p.20) has also remarked on the close relationship of the two genera.

Cox (1952, p.22) reported that cardinal crura were lacking in the type species of *Camptonectes*, *C. auritus*. However, Speden (1967, pl.4, figs 1 & 3) figured specimens of *C. auritus* which possess weak cardinal crura. Both *Camptonectes socialis* (Moore) and *C. aramacensis* sp. nov. described below have strong cardinal crura.

Numerous species have been referred to *Camptonectes* but many are not well differentiated. Some may belong to other genera. *Camptonectes* is a cosmopolitan genus.

Camptonectes socialis (Moore), 1870

Pl.48, figs 17-18

Synonymy:

1870 *Pecten socialis* Moore, p.248, pl.11, fig.9.

1892 *Pecten socialis* Moore; Etheridge Jnr, p.446, pl.21, fig.6 only.

1892 *Pecten* sp. ind. (? *P. socialis* or *P. psila* Tenison Woods); Etheridge Jnr, pl.21, fig.5.

1901 *Pecten socialis* Moore; Etheridge Jnr, p.13, (*pars*.).

1925 *Pecten* (*Camptonectes*) *socialis* (Moore); Whitehouse, p.28.

1927 Pecten (Camptonectes) sp. Whitehouse, p.145.

1961 Syncyclonema socialis (Moore); Woods, p.6.

1964 Camptonectes socialis (Moore); Day, table 3.

1966 Camptonectes socialis (Moore); Ludbrook, p.159, pl.16, figs 7,9,10.

1967b Camptonectes socialis (Moore); Day, p.19, pl.4, figs 1-3.

Type: Holotype: Lost. Locality: "Wollumbilla", Doncaster Member, upper Aptian. Neotype: (herein designated) F35521 UQ, a small right valve. Locality: RD90, Doncaster Member, upper Aptian.

Material: About 50 specimens most of which retain shell material.

Specific diagnosis: Small to large Camptonectes; ornament on body of shell subdued, consisting of delicate, closely spaced, concentric lamellae and innumerable microscopic, non-punctate radial costae; anterior auricle of right valve with growth lamellae only; posterior auricle of right valve with fine radiating costae which meet the dorsal margin at an angle of about 15°.

Description: Small to large (length 5-50mm). Subequivalve; weakly inflated; left valve more convex than the right valve. Subequilateral; body of shell suborbicular; expanded anteriorly. Dorsal margins straight; slightly inclined; usually forming more than half shell length.

Antero-dorsal and postero-dorsal margins meeting at an angle of 165° at the umbo. Umbones broad, central. Umbonal angle 85° - 95°. Auricles unequal, the anterior larger than the posterior. Right valve with a wide, shallow byssal notch and fine ctenolium. Anterior ear of right valve with a well developed fasciole. Hinge with distinct cardinal crura parallel to hinge line. Ligament pit triangular, flanked by ligamental crura. Musculature not known. Ornament on body of shell consisting of delicate, closely spaced concentric lamellae and innumerable, microscopic, non-punctate radial costae, (at least 250 at shell height 8mm). Radial costal diverge from mid-line and bifurcate. Ornament of right valve auricles as per specific diagnosis. Ornament of left valve auricles not known.

<u>Dimensions</u>: (mm)

	Length	Anterior length	Height	Length of Dorsal Margin	Anterior length of Dorsal Margin	Inflation	Umbonal angle
F35521UQ	8	4	9	5	3	2(1 valve)	95°
F35569UQ	25	3	28	12	7	4 (")	90°
F30505UQ	30+	c.15	28+	25	14	-	85°
F91856UQ	37	18	38	-	-	14	85°

<u>Remarks</u>: The holotype, a decorticated left valve from "Wollumbilla", figured by Moore (1870, pl.11, fig.9), was destroyed by fire in Sydney in 1882 (Etheridge Jnr, 1892,

p.xvi). The right valve now selected as neotype is from RD90. This locality is about 30 miles west of "Wollumbilla", but represents approximately the same stratigraphic horizon.

Species of Camptonectes described from the Mullaman Beds of the Northern Territory by Skwarko (1966) all have much coarser radial costae than C. socialis.

The differences between C. socialis and C. aramacensis sp. nov. are discussed in the following section.

Occurrence:

Minmi Member: "Red Hill" (Whitehouse, 1927); RD109; L143 GSQ; L150 GSQ; L319 UQ; L2162 UQ.

Doncaster Member: "Wollumbilla" (Moore, 1870); "bore at Mitchell Railway Station" (Etheridge Jnr, 1892); RD90; RD117; RD121; RD122; RD124; RD198; RD243; L98 GSQ; GAB1384; GAB1800; GAB1887; GAB2092; GAB2162; GAB2163; SB106?; SB117; SB125; SB129.

Blackdown Formation: "Walsh River" (Etheridge Jnr, 1892); W10 (Woods, 1961).

Maree Formation: "Peake Station" (Whitehouse, 1925) and numerous localities reported by Ludbrook (1966).

Age: Early - late Aptian.

Camptonectes aramacensis* sp. nov.

Pl.48, figs 11-16

*Named after Aramac, a locality from which representatives of the species were first described.

Synonymy:

1892 Pecten socialis Moore; Etheridge Jnr, p.446 (pars.), pl.21, figs 7,9 only.

1892 Pecten sp. ind. Etheridge Jnr, p.446, pl.21, figs 7,9.

1892 Pecten aequilineatus Moore ?; Etheridge Jnr, p.445 (pars.), pl.21, fig.8 only.

1901 Pecten socialis Moore; Etheridge Jnr, p.13 (pars).

1902a Syncyclonema? socialis (Moore); Etheridge Jnr, p.9 (pars.), pl.1, figs 11-12.

Types: Holotype: CPC9865, a ventrally incomplete external mould of a left valve. Paratypes: CPC9866, CPC9867, left valves showing interior features; CPC9868, a right valve showing interior features. Locality: Holotype and paratypes CPC9866 - CPC9867, BMR Longreach 5 (140'8"-140'9"); paratype CPC9868, BMR Longreach 5 (133'3"-133'6"). All specimens from the Coreena Member, lower Albian.

Material: About 400 specimens, many of which are incompletely preserved.

Specific diagnosis: Small Camptonectes; ornament on body of shell cancellate, consisting of very numerous, comparatively thick, radial costae that are interrupted by closely spaced, slightly imbricate concentric lamellae.

Description: Small (length rarely exceeding 10mm). Subequivalve; compressed, left valve slightly more convex than right valve. Subequilateral. Height slightly greater than length. Body of shell orbicular. Dorsal margins long and straight. Auricles unequal, the anterior larger than the posterior. Auricles not rising above hinge line. Right valve with a wide, shallow byssal notch. Umbones central. Umbonal angle 60-75°. Hinge with distinct cardinal crura parallel to hinge line. Ligament pit triangular, flanked by ligamental crura. Ligamental crura of left valve articulating inside those of right valve. Musculature not observed. Ornament on body of shell cancellate, consisting of numerous radial costae (approx. 60 costae at shell height 8mm), and well elevated, slightly imbricate, closely spaced, concentric lamellae. Radial costae very fine near umbo, thickening markedly towards lateral and ventral margins. Radial costae almost as wide as interspaces; diverging from mid-line; increasing by intercalation. Concentric lamellae interrupt radial ribs. Anterior auricle with raised growth lamellae parallel to anterior border and very fine radial costae. Posterior auricle with fine growth lamellae parallel to posterior border and fine radial ribs which meet the dorsal margin at an angle of approximately 30°.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation	Umbonal angle
CPC9865	9	4.5	8+	5	3	2(1 valve)	60°
CPC9866	8.5	4.2	10	6	3.5	3(")	75°
CPC9867	8.5	4	9.5	5	3	3(")	65°
CPC9868	3	1.5	3	2	1	1(")	70°
F1283 GSQ	11	5	11+	6	4	2(")	75°
F1371 GSQ	7	3.5	8.5	4	2	1.5(")	75°

Remarks: *Camptonectes aramacensis* sp. nov. is readily distinguished from the Aptian species *C. socialis* (Moore) by its cancellate ornament and comparatively coarse radial costae. Specimens from "Aramac" and "Rockwood Station" described by Etheridge Jnr (1892, pl.21, figs 7-9), and separated from *Camptonectes socialis* by Day (1967b, p.20), are here referred to *C. aramacensis* sp. nov. The specimen from South Australia figured by Etheridge Jnr (1902a, pl.1, figs 11-12) as *Syncyclonema* ? *socialis* is also referred to this new species.

Species of *Camptonectes* described from the Mullaman Beds of the Northern Territory by Skwarko (1966) lack the distinctive, closely spaced, imbricate, concentric lamellae of *C. aramacensis* sp. nov.

Occurrence:

Coreena Member: "Aramac" (Etheridge Jnr, 1892); GAB1380; GAB1701; GAB2088; SB109; BMR Longreach 5 (121'11"-140'9").

Allaru Mudstone: GAB1041; GAB1230; GAB1419; GAB1611; GAB1928; GAB1931; GAB1935; GAB2010; GAB2067; GAB2070; GAB2104; BMR Longreach 2 (114'2"-114'2½"); BMR Longreach 4 (132'6"-147').

Mackunda Formation: GAB674; GAB678; GAB813; GAB815; GAB817; GAB822; GAB823; GAB834; GAB911; GAB912; GAB913; GAB923; GAB930; GAB1107; GAB1109; GAB1204; GAB1208; GAB1212; GAB1214; GAB1219; BMR Longreach 2 (64'6"-64'8").

Maree Formation: "Primrose Springs, near the Peake" (Etheridge Jnr, 1902a).

Age: Early - early late Albian.

Family Entoliidae Korobkov, 1960

Remarks: Korobkov (1960) proposed this group as a subfamily of Pectinidae. It includes equivalve or subequivalve pectinoid shells, with a byssal notch that is either absent or seen only in early growth stages. The hinge usually has strong auricular and cardinal crura, the auricles are raised above the dorsal margins, and the exterior is smooth, ornamented with concentric ribs, or more rarely has radial striae. Newell (1965) elevated Korobkov's taxon to family rank.

The oldest member of the family is the Carboniferous and Permian genus Pernopecten Winchell. The Entoliidae became extinct at the close of the Cretaceous.

Genus Entolium Meek, 1865

Type species (by original designation): Pecten demissus Phillips, 1829, Middle Jurassic, England and Europe.

Generic diagnosis: Shell thin. Suborbicular. Equivalve or slightly inequivalve. Weakly inflated. Auricles equal in size, rising above hinge margin. Byssal notch very small in juveniles, absent in adults. Hinge with variably developed cardinal and auricular crura. Exterior smooth or with regular concentric ribs.

Range: Jurassic - Cretaceous.

Remarks: Entolium Meek, 1865, has been regarded as a synonym of Syncyclonema Meek 1864, by many authors including Woods (1902), Arkell (1930) and Stewart (1930). However, Speden (1967) has recently shown that the two are quite distinct. Speden (1967, p.15) observed considerable variation in the development of cardinal and auricular crura in species of Entolium and noted that the hinge features of the type species need clarification. Entolium is a cosmopolitan genus.

Entolium gradatum (Etheridge Jnr), 1902

Pl.48, figs 8-10

Synonymy:

1890 Pecten sp. Hudleston, p.244, pl.9, fig.5.

1892 Amusium sp. ind. Etheridge Jnr, p.447, pl.21, figs 4-4a.

1902a Protamusium (?) gradatum Etheridge Jnr, p.10, pl.1, fig.14.

1925 Pecten (Syncyclonema) gradatus (Etheridge Jnr); Whitehouse, p.29.

1966 Syncyclonema gradata (Etheridge Jnr); Ludbrook, p.160, pl.16, fig.8; pl.26, fig.17.

1966 Syncyclonema toodinensis Ludbrook, p.160, pl.16, fig.11.

Types: Protamusium (?) gradatum Etheridge Jnr. Holotype: T1344 AUGD. Locality: "Lake Eyre Basin", (Type locality designated by Ludbrook 1966, p.160, "Nilpinna 2,5/581/2, 4 miles east of Peake ruins", Maree Formation, Albian.

Syncyclonema toodinensis Ludbrook. Holotype: M1516 GSSA. Paratypes: M1639 GSSA, M1517 GSSA. Locality: "Toodina 5/570/11, Maree Formation, Albian.

Material: Fifteen separated valves.

Specific diagnosis: Small to quite large, thick shelled Entolium; hinge without auricular crura and with only one cardinal crus on each auricle; body of shell ornamented with strong, flat topped, concentric lamellae; ventral edges of lamellae projecting over concave interspaces.

Description: Small to quite large (length 10-60mm). Thick shelled. Equilateral. Suborbicular; height slightly exceeding length. Apparently equivalve. Weakly inflated. Antero-dorsal and postero-dorsal margins straight or very slightly concave, forming an angle of 90-110° at the umbones. Other margins convex. Umbones small, central. Auricles triangular, large, equal in size, projecting slightly above the hinge margin. No byssal notch. Hinge of right (?) valve with a raised platform bearing a deep, central, triangular ligament pit. Platform terminated anteriorly and posteriorly by oblique ridges extending from the base of the ligament pit to the dorso-lateral corners of the auricles. One cardinal crus on each auricle. No auricular crura. Musculature not observed. Auricles ornamented with growth lines paralleling the outer lateral margins. Ornament on body of shell as per specific diagnosis.

Dimensions: (mm)	Length	Length of dorsal margin	Height	Inflation	Umbonal angle
T1344 AUGD	23	10	25	5	90°
CPC9289	42	16	43	5	110°
CPC9290	35+	-	35+	4	110°
ANU 17902	22	8	24	3	100°

Remarks: The figure of the holotype (T1344 AUGD) given by Etheridge Jnr (1902a, pl.1, fig.14) is not a true representation of the specimen. The auricles of the holotype are not straight as shown in Etheridge Jnr's figure, but rise above the hinge margin. The ornament of the Queensland specimens matches that remaining on Etheridge Jnr's largely exfoliated holotype.

Amusium sp. ind. Etheridge Jnr (1892, p.447, pl.21, figs 4-4a) and *Syncyclonema toodinensis* Ludbrook (1966, p.160, pl.16, fig.11) differ from Etheridge Jnr's holotype solely in size. They are therefore considered to be conspecific with *Entolium gradatum*.

Protamusium ? *gradatum* Etheridge Jnr was referred to *Syncyclonema* Meek by Whitehouse (1925) and Ludbrook (1966). However, *Syncyclonema*, as revised by Speden (1967), has distinctly different hinge features, a byssal notch, and unequal auricles. Etheridge Jnr's species is now included in the genus *Entolium* Meek, as it lacks a byssal notch, and the auricles are of equal size.

Syncyclonema territorianum Skwarko (1966, p.83, pl.1, figs 13-17), which has the hinge and auricular features of *Entolium*, lacks the strong concentric lamellae of *Entolium gradatum*. *Entolium territorianum* occurs in "unit 2" of the Mullaman Beds and was assigned a late Neocomian age by Skwarko. As discussed in the section on Australian correlations, the age of "unit 2" is considered to be early Aptian.

The European Hauterivian - Cenomanian species

Entolium orbicularis (J. Sowerby) as figured by Woods (1902, pl.27, text fig.1) resembles *E. gradatum* (Etheridge Jnr) in shape, but has a different hinge morphology, and perhaps, finer exterior ornament.

In Queensland *E. gradatum* has been found only in the Allaru Mudstone.

Occurrence:

Allaru Mudstone: ? "Rockwood Station, Landsborough River" (Etheridge Jnr, 1892); GAB1419; GAB1611; GAB1612; GAB2028; GAB2049; GAB2069; GAB2070; GAB2104; tributary of Brutus Creek, about 1 mile S.E. of Currane homestead (grid ref. 260083 Longreach 1:250,000 sheet).

Maree Formation: "Hamilton Station near Lake Eyre" (Hudleston, 1890); "Lake Eyre Basin" (Etheridge Jnr, 1902a); "Peake Station" (Whitehouse, 1925); and several localities reported by Ludbrook (1966).

Age: Early late Albian.

Family Posidoniidae Frech, 1909

Remarks: This family comprises thin shelled, subequivalve, ovate or suborbicular, more or less oblique forms. The umbones are small and the auricles are ill-defined. A byssal notch is present only in the earliest growth stages. The ligament is small, triangular, external, and sometimes bears a few longitudinal grooves. There are no hinge teeth.

The ornament consists of concentric undulations sometimes crossed by radial ribs.

Many authors have included the nominate genus Posidonia in the Pteriidae or in families of the Pectinacea. The writer follows Imlay (1963), Cox (1965), Newell (1965) and Vokes (1967) in accepting Frech's family Posidoniidae. The family ranges from the Carboniferous to the Cretaceous. A pelagic habit has been inferred for several species of this family.

Genus Aulacomyella Furlani, 1910

Type species (by monotypy): Posidoniella problematica Furlani, 1910, Kimmeridgian, Dalmatia.

Generic diagnosis: Equivalve; feebly convex. Subequilateral; suborbicular; hinge line long and straight. Umbones subcentral. Auricles ill-defined. No byssal notch. Hinge features unknown. Ornament consisting of strong concentric growth undulations and straight, radial plicae.

Range: Kimmeridgian - ? Albian.

Remarks: Furlani (1910, footnote p',3) proposed Aulacomyella as a replacement name for Posidoniella Furlani (1910) non de Koninck, 1885. The genus was erected for a single species Posidoniella problematica Furlani (1910, p.85, pl.3 figs 2-3) which resembled Posidonia (called Posidonomya by Furlani) in the juvenile stage, but developed Halobia-like ribs in the adult stage.

Vokes (1967, p.184) referred *Aulacomyella* to the family Halobiidae and the general appearance of *Aulacomyella* does recall the Triassic genera *Halobia* Bronn and *Amonotis* Kittl. However, the hinge of *Aulacomyella* is unknown. The hinge of *Aulacomyella ? ludbrooki* sp. nov. described below appears to be identical with that of the Jurassic posidoniid *Bositra* as illustrated by Jeffries and Minton (1965). If the tentative inclusion of this species in the genus *Aulacomyella* is confirmed, reference of that genus to the Posidoniidae would be more secure.

According to Imlay (1945, p.264) *Aulacomyella* has been recorded only from the Middle Kimmeridgian of Dalmatia, British Somaliland, Mexico and the Gulf region of the U.S.A. *Aulacomyella* may also occur in the Jurassic of Japan (Hayami, 1961, p.252). Inclusion of the Australian Albian species *Aulacomyella ? ludbrooki* sp. nov. would greatly extend the stratigraphic and geographic range of the genus.

*Aulacomyella ? ludbrooki** sp. nov.

Pl.48, figs 1-7

*Named after Dr N.H. Ludbrook, formerly of the Geological Survey of South Australia, for her contributions to South Australian palaeontology.

Synonymy:

1966 *Pseudavicula* sp. nov. Ludbrook, p.154, pl.16, fig.5.

Types: Holotype: CPC9371, a right valve. Paratypes: CPC9841, a left valve; CPC9842, an incomplete right valve showing hinge features. Locality: Holotype BMR Longreach 4 (136'8"-136'10"); Paratype CPC9841, BMR Longreach 4 (178'11"-179'); Paratype CPC9842, BMR Longreach 4 (203'11"-204'). All from the Allaru Mudstone, lower upper Albian.

Material: About 250 specimens commonly fragmentary and usually occurring in aggregations.

Specific diagnosis: Small; very thin shelled; equilateral; ornament consisting of very numerous (approx. 60 at shell height 10mm), sharp radial plicae of at least two orders, widely spaced, inconspicuous concentric plicae and fine concentric growth lines; radial plicae finer and more closely spaced anteriorly, weakly developed on umbonal region, absent from posterior ears; radial plicae initially V-shaped, broadening towards margins and tending to become flat topped and wider than interspaces.

Description: Small (height 10-20mm). Very thin shelled. Equilateral. Orbicular; height slightly greater than length. Slightly inequivalve; right valve almost flat; left valve weakly convex. Postero-dorsal margins straight, about one-third of shell length. Other margins gently convex. Posterior ears of both valves not sharply defined from body of shell. Posterior margin of posterior ears meeting postero-dorsal margin almost at right angles;

slightly sinuate below this junction. Anterior ear not developed in either valve. Umbones small, subcentral; beaks projecting slightly above hinge line. Hinge plate thin, simple. Ligament pit shallow, triangular, extending anteriorly and posteriorly from the beak. Ornament as per specific diagnosis.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
CPC9371	9	4	10	4	1	1 (right valve)
CPC9841	12	6	12.5	5	1.5	1.5(left valve)
ANU 17893	17	8	18	8	3	2 (")
ANU 17894	15	8	16	8	3.5	1.5(right valve)
ANU 17895	16	-	10+	6	2	2 (left valve)

Remarks: The hinge of Aulacomyella ? ludbrooki sp. nov. has a shallow ligament pit in the form of an equilateral triangle with the beak situated at the apex. As mentioned above, this hinge appears to be identical with that of the Jurassic posidoniid Bositra as illustrated by Jeffries and Minton (1965). The hinge of Pseudavicula, with its asymmetrically triangular ligament pit lodged behind the beaks and its hinge plate reduced in width anteriorly, is quite distinct.

Posidoniella problematica Furlani (1910, p.85, pl.3, figs 2-3), the type species of Aulacomyella from the middle

Kimmeridgian of Dalmatia, has comparable plicate radial ornament, but the concentric plicae are wider and more prominent than those of Aulacomyella ? ludbrooki. The Australian form is tentatively referred to the genus Aulacomyella as the hinge of the type species is unknown and the previously described species of that genus are all of Jurassic age.

Aulacomyella neogeae Imlay (1940, p.406, pl.52, figs 1-6; pl.53, fig.26) from the middle Kimmeridgian of Mexico has less prominent concentric plicae than A. problematica (Furlani). The ornament of Imlay's species is thus closer to that of A. ? ludbrooki. Both Jurassic species differ from A. ? ludbrooki in their development of radical plicae on the posterior ears.

Aulacomyella ? ludbrooki sp. nov. is readily distinguished from Pseudavicula anomala by its more equilateral form and its radial plicae, many of which are wider than the interspaces. In Pseudavicula anomala (Moore, 1870) the ornament of unexfoliated surfaces is reticulate, with fine non-plicate radial ribs that are narrower than the interspaces.

Aulacomyella ? ludbrooki sp. nov. is widely distributed in early late Albian sediments of the Northern Eromanga Basin. The form also occurs in the Wolena Claystone of the Laura Basin (Woods, 1963b) and in South Australia (Ludbrook, 1966), where it was reported by both workers as Pseudavicula sp. nov. Judging from its description, the unfigured Pseudavicula sp. of Glaessner (1945, p.158) from late Albian sediments in New Guinea, may be related.

Occurrence:

Toolebuc Limestone: GAB945; GAB947; GAB948; GAB1130.

Allaru Mudstone: GAB1085; GAB1604; GAB2063?; Tributary of Brutus Ck about 1 mile S.E. of "Currane" (grid ref. 260083 Longreach); BMR Longreach 4 (72' - 293'5").

Wolena Claystone: "Near crossing of Weiss Ck by Laura-Coen road, 9.3 miles S.E. of crossing of Hann River (Woods, 1963b).

Maree Formation: "Yardinna 5/550/1 and Cootanoorina 5/580/1" (Ludbrook, 1966).

New Guinea: " ? Feing Group" (Glaessner, 1945).

Age: Early late Albian.

Family Oxytomidae Ichikawa, 1958

Remarks: Ichikawa (1958, p.158) proposed this taxon as a subfamily of Aviculopectinidae. He included the genera Oxytoma Meek, Maccoyella Etheridge Jnr, and Meleagrinella Whitfield. These genera resemble aviculopectinids in shape and ornament, but possess a discontinuous pallial line (as in Recent Pteriidae), a calcitic inner ostracum with crossed lamellar structure, and reduced anterior ears.

Cox (1962, p.592) elevated the Oxytominae to family rank and apparently considered Pseudavicula Etheridge Jnr a member of that family. Jeletzky (1963) subsequently referred Aucellina Pompeckj, Arctotis Bodylevsky, and Malayomaorica Jeletzky to the family. Vokes (1967, p.183) placed Aucellina in the family Buchiidae, Pseudavicula in the Streblopteriidae (p.184) and listed as members of the Oxytomidae the following genera:- Oxytoma and its subgenera Hypoxytoma Ichikawa and Palmoxytoma Cox, Arctotis Bodylevsky, Malayomaorica Jeletzky, Ostreavicula Blanckenhorn, Meleagrinella Whitfield, Echinotis Marwick (generally considered a synonym of Meleagrinella), Maccoyella Etheridge Jnr, and Mimetostreon Bonarelli (a synonym of Maccoyella).

Genera currently referred to the Oxytomidae have quite diverse hinge morphologies (Fig.16). The simple hinge of Oxytoma stands in distinct contrast to the complex type developed in Maccoyella. Further study may lead to a finer subdivision of the group. The relationship of the Oxytomidae to the Buchiidae is still in need of clarification.

Throughout the Mesozoic oxytomids are very common and widely distributed. They are of considerable value in correlation, particularly in the Jurassic and Cretaceous. The Oxytomidae became extinct at the close of the Cretaceous.

TEXT FIG. 16

HINGE FEATURES OF SOME OXYTOMID GENERA

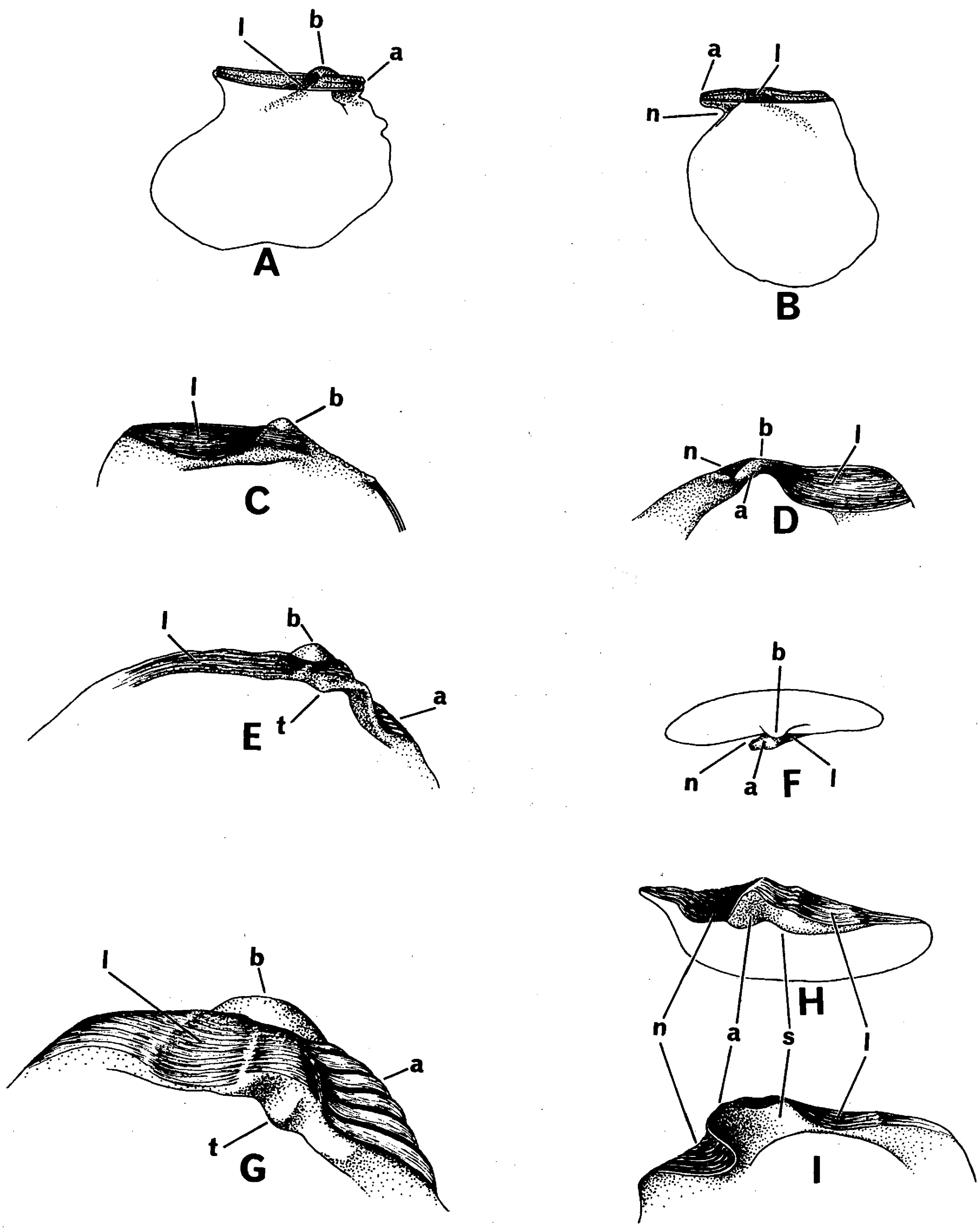
A-B Oxytoma inequivalvis (J. Sowerby). A L8959 BMNH, lateral view of interior of left valve, X1.2 (approx.); locality Oxford Clay, St Ives, England. B L17597 BMNH, lateral view of interior of right valve, X2; locality Middle Lias, Stroud, England.

C-D Pseudavicula anomala (Moore). C topotype F35509 UQ, lateral view of hinge of left valve valve, X3; locality RD122, Doncaster Member, Wallumbilla Formation, late Aptian. D topotype F35508 UQ, lateral view of hinge of right valve, X2.7; same locality.

E-F Meleagrinella woodsi Day. E holotype F35510 UQ, lateral view of hinge of left valve, X2.6 (approx.); locality RD99, Minmi Member, Blythesdale Formation, early Aptian. F paratype F35666 UQ, dorsal view of hinge of right valve, X1.8 (approx.); same locality.

G-H-I Maccoyella barklyi (Moore). G topotype F35504 UQ, lateral view of hinge of left valve, X1.25; same locality as F35509 UQ. H topotype F35501 UQ, dorsal view of hinge of right valve, X1.25; same locality. I Same, lateral view of hinge, X1.25.

a anterior ear; b beak; l ligament; n byssal notch; t tooth; s socket.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Genus Aucellina Pompeckj, 1901

Type species (by subsequent designation Marwick 1939, p.463): Avicula gryphaeoides J. Sowerby, 1837, upper Albian - lower Cenomanian, England and Europe.

Generic diagnosis: Generally small to medium sized. Thin shelled. Gryphaeoid; subequilateral or inequilateral. Inequivalve. Left valve erectly ovate, strongly inflated, larger than right valve. Right valve suborbicular, weakly inflated. Umbones anterior to subcentral. Left valve umbo prominent, broad or narrow; beak distinct from and frequently overhanging the hinge margin. Right valve umbo small and broad. Anterior ear of left valve small and slightly crenulate. Anterior ear of right valve large, hollowed out internally; articulating below the left valve anterior ear. Byssal notch wide and deep. Margins bordering byssal notch sometimes crenulate. Posterior ears of both valves usually small, triangular, well defined. Hinge plate in left valve narrow, inclined inwards or outwards or lying more or less within the plane of commissure. Hinge plate in right valve inclined outwards or set almost at right angles to the plane of commissure. Ligament pit more or less triangular and transversely elongated in both valves. Left valve ligament pit extending both in front of, and behind, the umbo. Anterior end of ligament pit foreshortened in specimens with distorted anterior ears.

Musculature and pallial features rarely well impressed. Monomyarian. Posterior adductor scar subcircular and subcentral. Exterior ornamented with strong or weak, minutely zig-zag radial ribs together with fine concentric growth lamellae or concentric growth lamellae only.

Range: Tithonian ? Neocomian - Cenomanian.

Remarks: Pompeckj (1901) in proposing *Aucellina* discussed the morphology and affinities of the genus in some detail. However, the structure of the hinge of the left valve has remained poorly understood (Jeletzky, 1963). Wollemann (1906, pl.6, figs 8-8a) illustrated a left valve of *Aucellina aptiensis* (d'Orbigny) with a *Meleagrinella*-like hinge possessing a distinct, tooth-like thickening of the hinge plate in front of the umbo and a feeble articulation furrow or "gelenkegrube". Jeletzky (1964, pl.18, figs 3C-D) figured as *Aucellina* n. sp. *A.* aff. *aptiensis* (d'Orbigny), a left valve with a *Buchia*-like hinge with an anterior tooth-like thickening and a downwardly deflected anterior ear that places the umbo at the anterior end of the hinge line. In addition, Jeletzky (1964, pl.28, fig.4c) figured as *Aucellina aptiensis* (d'Orbigny) var. *nassibianzi* Sokolov, a left valve with a *Meleagrinella*-like hinge with a faint, anterior, tooth-like bulge. Damaged left valves of aff. *Aucellina* n. sp. and *Aucellina* cf. *hughendenensis* (Etheridge Snr) illustrated in line drawings by Marwick (1966, figs 4,5,11,12) appear to resemble hinges of _Meleagrinella_ and _Buchia_ respectively. Recently Dr I.G. Speden of the New Zealand Geological Survey has sent me photographs of the hinge of a left valve (NZGS WM9042) of the type species of _Aucellina_, _Avicula gryphaeoides_ (J. Sowerby) from the Cambridge Greensand, England. This shows a narrow, uncomplicated hinge plate like that of _Oxytoma_, with a transversely elongated, more or less triangular ligament pit extending anteriorly and posteriorly from beneath a subcentral, overhanging beak.

Part of the variation in hinge morphology of the left valve is evidently a function of the variation in position and development of the anterior ear. In specimens of _Aucellina_ cf. _gryphaeoides_ with comparatively large, undistorted anterior ears, the ligament pit extends in front of the subcentral beak, and the hinge is oxytomid in character. Other specimens have a small anterior ear deflected inwards and bent below the hinge line so that the ligament pit tends to terminate near the beak, which becomes anterior, and the hinge is buchiid-like. The reduction and ventral deflection of the anterior ear of the left valve probably results from a lack of space for its development, which, in turn, is consequent upon the species's crowded growth habit. Thus the observed variation in hinge features is probably an inherently individual feature.

The wide variation exhibited by hinges of several left valves of Aucellina cf. gryphaeoides prepared by Dr I.G. Speden tends to verify this viewpoint. Under the circumstances, it would be unwise to erect new taxa based solely on individuals with aberrant hinges.

Aucellina has been included in the family Buchiidae by most authors. Ichikawa (1958) and Jeletzky (1963) have considered this taxon as a subfamily of Aviculopectinidae. Brunnschweiler (1959b) proposed a new subfamily of aviculopectinids, the Aucellininae, for the reception of Aucellina. Jeletzky (1963) referred the genus to the Oxytomidae (treated by him as a subfamily of Aviculopectinidae). Occurrences of left valve hinges resembling those of Buchia, Oxytoma and Meleagrinella, in species referred to Aucellina, make assessment of the family relationships of Aucellina difficult. However, as the hinge of the type species of Aucellina approaches that of Oxytoma, the genus is now included in the Oxytomidae. When more is known of the variation of the hinge of the left valve and when the phylogeny of the group is better documented, the adoption of Brunnschweiler's subfamily Aucellininae may be preferable.

Pompeckj (1901) discussed at length the relationship of Aucellina to Buchia (=Aucella of Pompeckj) and Meleagrinella (=Pseudomonotis of Pompeckj). This has also been considered briefly by Jeletzky (1963). Aucellina approaches *Buchia* in exterior form but the ornament, except in the youngest species is closer to that of *Meleagrinella*. *Malayomaorica* Jeletzky (1963) resembles *Aucellina* superficially, but has a much more massive hinge plate.

Paraucellina Pavlov (1907, p.86, p.19), monotype *Paraucellina krasnopolskii* Pavlov (1907, p.89, pl.6, figs 38a-d, 39a-d, 40a-b, 41a-e) from the Cenomanian of Central Russia appears to differ from typical *Aucellina* principally in its abnormally large left valve anterior ear. At best the taxon warrants only subgeneric rank and it is treated as a subgenus of *Aucellina* by Eberzun (1960).

Aucellina occurs in vast numbers in Australian Albian sediments and commonly forms coquinas in the Toolebuc Limestone, Allaru Mudstone and the Mackunda Formation. The convex left valves are generally segregated from the flat right valves. Only rarely are specimens found with valves still in apposition. Parallel occurrences were reported from the Caucasus by Khalilov (1954) and they are doubtless typical of the genus. The morphology and mode of occurrence of *Aucellina* clearly indicate that it was an attached epifaunal "mussel" living in gregarious masses in seas subject to periodic bottom disturbances. Under the cramped and crowded conditions of growth in this habitat considerable variation in individual shell shape is to be expected within a single population. As most workers have not taken this variation into account, numerous species of *Aucellina* have been named. Donovan (1953, p.91) has suggested many would not survive critical revision. Several workers, notably Pavlov (1907), Sokolov (1908) and Wollemann (1908) have based species on what appear to be aberrant individuals. Evaluation of such species cannot be undertaken from published figures, but must be based on large topotypic samples which reveal the individual variation. In this respect, a close analogy may be drawn between *Aucellina* and *Buchia*. The latter led the same gregarious epifaunal life and was similarly oversplit by earlier workers (Imlay, 1959) (Jeletzky, 1965). Species of *Aucellina* like those of *Buchia* are potentially very valuable in local and intercontinental correlation, but injudicious lumping will deny the stratigraphic merit of the group.

According to Jeletzky (1958, p.13) *Aucellina* may have appeared in Arctic regions as early as late Tithonian. However, little is known of the hinge features of these early forms. Jeletzky, also cited reports of the genus by Sokolov (1912) from the Valanginian of the far east of U.S.S.R. and the Barremian of the Caucasus. Later Jeletzky (1964) illustrated species of *Aucellina* from the Barremian of Arctic Canada. Vereshchagin (1964) also records the genus from the Barremian or late Hauterivan of the far east of the U.S.S.R. Aucellina became extinct during the Cenomanian. In general, older (Neocomian-early Albian) species of Aucellina characteristically have broad left valve umbones and strong radial ornament. Younger (late Albian-early Cenomanian species) typically have narrow left valve umbones and the radial ornament is weak or absent.

Aucellina is a characteristic genus of Boreal and Arctic faunas and is also well represented in Southern Hemisphere faunas of areas remote from Tethys. Pompeckj (1901) recorded the genus from England, France, Northern Germany, the Alps, Caucasus, India and Australia. Aucellina has since been reported from central U.S.S.R. (Pavlov, 1907), far eastern U.S.S.R. (Sokolov, 1912), western Canada (McLearn, 1945, 1948), Arctic Canada (Jeletzky, 1958), Alaska (Imlay, 1960) (1961), Greenland (Donovan, 1953), Spitsbergen (Frebold, 1930) (Sokolov & Bodylevsky, 1931) (Weir, 1933), Patagonia (Bonarelli, 1927) (Feruglio, 1937), Antarctica (Cox, 1953), South Georgia (Wilckens, 1947), South Africa (Rennie, 1936), and New Zealand (Woods, 1917).

Aucellina cf. radiatostriata Bonarelli, 1921

Pl.49, figs 3-6

Synonymy:

cf. 1921 Aucellina coquandiana (d'Orb.) var. radiato-striata Bonarelli, p.27, pl.5, fig.1.

cf. 1921 Aucellina hughendenensis (Etheridge Snr); Bonarelli, p.21, pl.2, figs 7-8.

cf. 1925 Aucellina caucasica v. Buch var. striata Richter, p.539 (pars.), pl.8, fig.15 only.

cf. 1937 Aucellina andina Feruglio, p.22, pl.1, figs 12-16.

cf. 1937 Aucellina bonarellii Feruglio, p.24, pl.1, figs 17-18.

cf. 1938 Aucellina coquandiana (d'Orb.) var. radiato-striata Bonarelli; Piatnizky, p.78, pl.3, fig.12; pl.4, fig.16.

cf. 1939 Aucellina sp. Marwick, p.463.

cf. 1947 Aucellina radiatostriata Bonarelli & Nagera; Wilckens, p.30, pl.2, fig.9; pl.4, figs 1-8.

cf. 1949 Aucellina bonarellii Feruglio; Camacho, p.252, pl.1, fig.4.

cf. 1949 Aucellina andina Feruglio; Camacho, p.252, pl.1, fig.5.

cf. 1949 Aucellina caucasica v. Buch var. striata Richter ?; Camacho, p.252, pl.1, fig.6.

cf. 1949 Aucellina richteri Camacho, p.252, pl.1, fig.7.

cf. 1953 Aucellina andina Feruglio; Cox, p.6, pl.1, figs 1-6.

cf. 1953 Aucellina radiato-striata Bonarelli & Nagera; Cox, p.8, pl.1, figs 7-10.

cf. 1959 Aucellina n. sp. aff. pavlovi Sok.; Fleming in Wellman, p.151.

cf. 1959 Aucellina cf. aptiensis (d'Orb.); Fleming in Wellman, p.152.

Material: One left valve and two right valves.

Description: Medium sized (length 25-35mm). Subequilateral. Left valve erectly ovate; length about 75% of height; dorsal margins steeply arched; slightly expanded postero-ventrally. Right valve suborbicular, slightly produced postero-ventrally. Inequivalve. Left valve strongly inflated. Right valve smaller than left valve, moderately or weakly inflated umbonally, flattened near the lateral and ventral margins. Umbo of left valve broad, rising above hinge line. Beak not conspicuous, very slightly prosogyral. Umbo of right valve prominent, prosogyral. Anterior ear of left valve small. Anterior ear of right valve short, slightly upturned, separated from body of shell by a wide, byssal notch. Posterior ear of left valve long, narrow. Posterior ear of right valve small. Hinge features and musculature not observed. Exterior surfaces of both valves bearing numerous, comparatively broad, minutely zig-zag, radial ribs that thicken ventrally, together with fine concentric growth lamellae and irregularly spaced concentric folds marking growth halts; radial ribs interrupted and sometimes flexed after growth halts.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
CPC9226	35	12	48	12 (left valve)
CPC9225	27	10	20+	5 (right valve)
CPC9224	25+	-	16+	3 (")

Remarks: The brief description of Aucellina radiatostriata given by Bonarelli (1921, p.27) may be translated as :- "Differs from typical A. coquandiana d'Orb., by exhibiting radial fluting on both valves. Several examples." Bonarelli's poor illustration (pl.5, fig.1) shows a left valve with broad umbones (left hand specimen) and a well inflated right valve (right hand specimen). Both valves are expanded postero-ventrally and bear fine radial ribs and irregularly spaced concentric folds. The right and left valves figured by Bonarelli (1921, pl.2, figs 7-8) as Aucellina hughendenensis (Etheridge Snr), have similar broad umbones and radial ornament, but are smaller and more equilateral. They may represent juvenile specimens of A. radiatostriata. Bonarelli (1921) erroneously assigned his A. hughendenensis and A. radiatostriata an Albian and a Cenomanian age respectively. Both are from the Lake San Martin area of

Patagonia, where they are associated with late Aptian species of the ammonites Sanmartinoceras, Tropaeum and Aioloceras.

The interpretation of Aucellina radiatostriata adopted here is closest to that of Wilckens (1947, p.30). He included in this species Aucellina andina Feruglio (1937, p.22, pl.1, figs 12-16) based on Bonarelli's A. hughendenensis and specimens from the Lake Argentino district of Patagonia, together with A. bonarellii Feruglio (1937, pl.1, figs 17-18) founded on right valves from the last mentioned locality. Possibly the right valve from Tierra del Fuego figured by Richter (1925, pl.8, fig.15) as Aucellina caucasica v. Buch var. striata (but not the specimen of pl.8, fig.16) should be included in A. radiatostriata, together with the Tierra del Fuego specimens described by Camacho (1949, p.252, pl.1, figs 4-7) as Aucellina bonarellii Feruglio, A. andina Feruglio, A. caucasica v. Buch var. striata Richter ? and A. richteri sp. nov.

Through the courtesy of Dr I.G. Speden of the New Zealand Geological Survey, I have examined casts of specimens described by Cox (1953) from Alexander I Land, Antarctica, as Aucellina andina and A. radiatostriata. These are probably representatives of only one species and compare closely with the three Australian specimens. The left valve in the present collection (CPC9226) bears a striking resemblance to those figured by Cox (1953, pl.1, figs 7 & 10). However, the specific identity of the Australian form cannot be securely established from a sample of only three specimens.

Some specimens of Aucellina radiatostriata Bonarelli approach the Albian species A. hughendenensis (Etheridge Snr) in postero-ventral expansion, but the former is usually readily identified by its stronger radial ornament and broad left valve umbo.

Dr I.G. Speden has kindly furnished casts of specimens from the Korangan Stage of New Zealand. A direct comparison of these with the Australian specimens shows that all probably belong to the one species. The New Zealand form was identified by Marwick (1939, p.463) as Aucellina sp., and by Fleming in Wellman (1959, pp.151-152) as Aucellina n. sp. aff. pavlovi and A. cf. aptiensis. The occurrence within the Korangan Stage, of species of Aucellina and Maccoyella identical with Australian species that occur in association with late Aptian ammonites, strengthens the currently accepted correlation of the Korangan with the Aptian stage.

Casts of the type specimens of Aucellina euglypha Woods (1917, p.9, pl.3, figs 4-8), from the Motuan Stage of New Zealand (=Upper Albian-Cenomanian), also supplied by Dr Speden, show that left valves of this species have even stronger radial ornament than those of _A. radiatostriata_, while the right valves have a quite distinctive sparse radial orrament.

Judging from numerous published figures, including those of Wollemann (1906, pl.6, figs 6-8), Pavlov (1907, pl.6, figs 22-23, 28-32), and Sokolov (1908, pl.5, figs 1-5, 9-11), Drushchitz & Kudryavtzev (1960, pl.3, figs 7-11), the European Aptian-early Albian species _Aucellina aptiensis_ (d'Orbigny) and _A. caucasica_ (v. Buch) have broad left valve umbones and radial ornament resembling that of _A. radiatostriata_. However, _A. aptiensis_ is typically more equilateral and somewhat orbicular in outline, while left valves of _A. caucasica_ have much stouter umbones. The illustrations of _Aucellina pavlovi_ Sokolov (1908, p.75, pl.5, figs 6a-b) do not provide an adequate basis for close comparison with _A. radiatostriata_ Bonarelli.

The occurrence of species closely allied to _Aucellina radiatostriata_ in Australia, New Zealand, Antarctica, South Georgia and southern-most South America is quite remarkable and has important palaeogeographic implications.

Occurrence:

Doncaster Member: GAB1036; GAB1117; GAB1118.

Age: Late Aptian.

Aucellina hughendenensis (Etheridge Snr), 1872

Pl.49, figs 7-14

Synonymy:

1872 Avicula hughendenensis Etheridge Snr, p.346, pl.25, fig.3.

1889 Aucella hughendenensis (Etheridge Snr); Tate, p.230.

1892 Aucella hughendenensis (Etheridge Snr); Etheridge Jnr, p.460, pl.25, figs 1-6.

1901 Avicula hughendenensis Etheridge Snr; Pompeckj, p.359.

1901 Aucellina hughendenensis (Etheridge Snr); Pompeckj, p.365.

1902a Aucella hughendenensis (Etheridge Snr); Etheridge Jnr, p.14.

1902b Aucella hughendenensis (Etheridge Snr); Etheridge Jnr, p.16, pl.5, figs 6-7.

1902 Aucella hughendenensis (Etheridge Snr); Etheridge Jnr & Dun, p.67 (pars.).

1905 Aucella hughendenensis (Etheridge Snr); Etheridge Jnr, p.13, pl.1, figs 10-13.

1907 Aucella hughendenensis (Etheridge Snr); Etheridge Jnr, p.321, pl.58; pl.61, figs 7-12.

1914 Aucella hughendenensis (Etheridge Snr); Sussmilch, fig.76,6.

1924 Aucellina hughendenensis (Etheridge Snr); Gillet, p.35.

1928 Aucellina hughendenensis (Etheridge Snr); Whitehouse, p.278.

1950 *Aucellina hughendenensis* (Etheridge Snr); David & Browne, p.498, pl.44, fig.a.

1953 *Aucellina hughendenensis* (Etheridge Snr); Cox, p.7.

1959b *Aucellina* sp. nov. A. aff. *A. aptiensis* (d'Orbigny); Brunnschweiler, p.14, text fig.1.

1959b *Aucellina* sp. nov. B. cf. *A. gryphaeoides* (Sowerby); Brunnschweiler, p.15, text fig.2.

1959b *Aucellina* sp. nov. C. cf. *A. hughendenensis* (Etheridge Snr); Brunnschweiler, p.16, text fig.3.

1959b *Aucellina hughendenensis* (Etheridge Snr); Brunnschweiler, p.13, p.17, text fig.4.

1961 *Aucellina hughendenensis* (Etheridge Snr); Woods, p.4.

1965 *Aucellina hughendenensis* (Etheridge Snr); Day, p.419.

1966 *Aucellina hughendenensis* (Etheridge Snr); Ludbrook, p.155, pl.18, figs 3,7,8.

1966 *Aucellina hughendenensis* (Etheridge Snr); Skwarko, p.81, pl.1, figs 9-12.

Type: Lectotype: (now selected) F3848 QM. Locality: "Hughenden Station", Ranmoor Member, lower or lower middle Albian.

Material: About 10,000 separated right and left valves usually occurring in coquinas.

Specific diagnosis: Small to large *Aucellina*; juveniles subequilateral; mature forms inequilateral, with a pronounced posterior obliquity; left valve umbo typically narrow; exterior of both valves bearing very numerous, fine, minutely zig-zag radial ribs; umbonal region of some juvenile left valves with markedly stronger radial ribs.

Description: Small (length 3mm) to large (length up to 50mm). Inequivalve. Left valve strongly inflated; larger than right valve. Right valve flat or weakly inflated. Juvenile left valves subequilateral, more-or-less acline. Mature left valves highly inequilateral, generally opisthocline and strongly produced postero-ventrally. Juvenile right valves suborbicular. Mature right valves markedly produced postero-ventrally. Left valves with a variably developed postero-ventral sulcus. Umbones subcentral to anterior, depending on degree of obliquity. Umbones of left valve almost invariably narrow, very rarely broad; rising well above, and overhanging hinge line. Beak sharply pointed, orthogyral or slightly prosogyral; sometimes situated almost at the anterior extremity of the hinge line. Umbones of right valve broad. Beak small, strongly prosogyral. Left valve anterior ear very small, sometimes bent inwards and deflected well below the line of the hinge. Anterior ear of right valve large, commonly upturned and rising above the hinge margin; articulating beneath the anterior ear of the left valve. Interior of right valve anterior ear hollowed out. Byssal notch wide, deep and crenulate. Posterior ears large, triangular; well defined in both valves. Hinge line short. Hinge plate of left valve narrow, inclined inwards, outwards or lying more-or-less within the plane of commissure. Hinge plate of right valve inclined outwards or set almost at right angles to the plane of commissure. Ligament pit in left valve small; posterior boundary a low, opisthocline ridge; anterior boundary indistinct, prosocline. Ligament pit of right valve asymmetrically triangular; anterior boundary of ligament pit formed by the raised, posterior edge of the anterior ear; posterior boundary formed by the shelf-like junction of hinge plate and postero-dorsal margin of shell. Musculature and pallial features not observed. Ornament on both valves of typical specimens consisting of very numerous (about 100 at shell height 15mm), fine, minutely zig-zag radial ribs, together with fine, closely spaced, concentric growth lamellae and irregularly spaced, broad concentric folds. Umbonal region of some juvenile left valves with markedly stronger ornament. Radial ribbing sometimes interrupted and sometimes offset after growth halts.

<u>Dimensions</u>: (mm)	Length	Anterior length	Height	Inflation
Left valves				
F3848 QM	30	7	25	8
CPC9240	37	9	37	-
CPC9239	17	6	18	6
CPC9241	10	4	11	4
CPC9815	9	4	10	5
Right valves				
F10758 GSQ	35	12	33	4
CPC9271	29	9	26	5
CPC9838	21	6	23	-
CPC9270	11	6	10	2

<u>Remarks</u>: <u>Aucellina hughendenensis</u> (Etheridge Snr), as now interpreted, is a highly variable species. Typical left valves, like the lectotype now selected (F3848 QM), have narrow umbones, a pronounced posterior obliquity, and numerous, very fine, minutely zig-zag, radial ribs. Typical right valves are expanded postero-ventrally, weakly inflated and have large posterior ears. However, individuals that depart widely from this form may be observed in almost every large collection. In shape, immature specimens are almost equilateral, while mature forms are highly inequilateral and produced postero-ventrally. Collections from the Toolebuc Limestone and Allaru Mudstone sometimes contain quite coarsely ornamented juvenile left valves. In future

studies, it may be useful to separate these subspecifically from typical A. hughendenensis occurring in the Ranmoor and Coreena Members.

The left valve hinges of several specimens of Aucellina hughendenensis (Etheridge Snr) with small, ventrally deflected anterior ears, are foreshortened anteriorly. They resemble that of a specimen from the Barremian of Arctic Canada figured by Jeletzky (1964, pl.18, figs 3C-D) as Aucellina n. sp. A (aff. aptiensis d'Orbigny), but lack the tooth-like bulge of the Canadian form.

Right valves described by Brunnschwiler (1959b, text figs 1-4) as Aucellina sp. nov. A aff. A. aptiensis (d'Orbigny), A. sp. nov. B cf. A. gryphaeoides (Sowerby), A. sp. nov. C cf. A. hughendenensis (Etheridge Snr) are now housed in collections of the Geological Survey of South Australia. The writer has examined these and agrees with Ludbrook (1966, p.181) that all should be referred to A. hughendenensis (Etheridge Snr). However, Aucellina sp. nov. E cf. A. incurva (Etheridge Jnr) and A. sp. nov. F aff. A. incurva (Etheridge Jnr), the specimens of which are not housed with the preceding ones and may be lost, are doubtfully included in Aucellina cf. gryphaeoides (J. Sowerby).

Aucellina cf. radiatostriata Bonarelli (1921) from the Doncaster Member may be distinguished from *A. hughendenensis* by its consistently stronger radial ribbing over the entire exterior of both valves, broader left valve umbo, and generally by its more equilateral form. However, there is some overlap in shape as rare left valves of *A. hughendenensis* have broad umbones.

Forms identified as *Aucellina* cf. *gryphaeoides* (J. Sowerby) differ from *A. hughendenensis* in being virtually smooth on later parts of the shell and are less expanded postero-ventrally.

Occurrence:

Ranmoor Member: "Hughenden Station" (Etheridge Snr, 1872); GAB668; GAB1122; GAB1123; GAB1124; GAB1125; GAB1126; GAB1127; GAB1128; GAB1131; GAB1132; GAB1133; GAB1142; GAB1144; BMR Richmond 1 (110'8"-111').

Coreena Member: "Aramac Well (244ft)"; "Coreena woolshed, 24 miles S. of Aramac" (Etheridge Jnr, 1892); GAB1387; GAB1400; GAB1408; GAB1433; GAB1438; GAB1439; GAB1700; GAB1701; GAB1702; GAB1704; SB101; BMR Longreach 5 (104'6"-147'7").

Toolebuc Limestone: "Barcoo River, right bank 6 miles above Northhampton Downs" (Etheridge Jnr, 1892); GAB642; GAB661; GAB684; GAB685; GAB692; GAB752; GAB753; GAB754; GAB755; GAB771; GAB772; GAB773; GAB774; GAB777; GAB778; GAB779; GAB791; GAB798; GAB800; GAB801; GAB803; GAB820B;

GAB932; GAB945; GAB946; GAB946B; GAB947; GAB948; GAB949; GAB951; GAB1002; GAB1003; GAB1005; GAB1014; GAB1119; GAB1120; GAB1129; GAB1130; GAB1401?; GAB1434?; GAB1435; GAB1926; GAB2035; GAB2036; GAB2106; Exoil Brookwood No.1 (Core 3 1480'-1500'); BMR Longreach 5 (95'-99').

Allaru Mudstone: "Warriana bore (351ft)"; "Flinders River, 7 miles above Marathon Station"; "Marathon"; "Neelia River at crossing of Concurry road"; "Jirking Creek near its head"; "Stone Hut, Rockwood Creek, Landsborough River"; "Landsborough River 5-1/2 miles N.N.W. of Rockwood Station"; "Leichhardt River, 7 miles from mouth of Gunpowder Creek" (Etheridge Jnr, 1892); "sources of Barcoo, Ward and Nive Rivers" (Etheridge Jnr, 1907); GAB602; GAB769; GAB802; GAB882; GAB1085; GAB1206?; GAB1221; GAB1222; GAB1230; GAB1394; GAB1615; GAB1927; GAB1929; GAB1935; GAB2008; GAB2009; GAB2010; GAB2018; GAB2025; GAB2028; GAB2033; GAB2034; GAB2046;1 GAB2048; GAB2049; GAB2050; GAB2054; Exoil Brookwood No.1 (Core 1 506'-516'; Core 2 990'-1000'); A.A.O. Penrith No.1 (Core 2 1040'-1050'; Core 3 1600'-1610'); BMR Longreach 2 (122'1"-122'2"); BMR Longreach 4 (53'9"-276').

Mackunda Formation: GAB2103; BMR Longreach 2 (72'8"-86').

Trimble Formation: "Trimble's Crossing, where a causeway for the new Wrotham Park-Dunbar road crosses the Walsh River" (Woods, 1961).

Wolena Claystone: Several localities reported by Woods (1962b) (1963b).

Mullaman Beds: TT60 (Skwarko, 1966).

Maree Formation: Numerous localities reported by Ludbrook (1966).

N.S.W.: Several localities reported by Etheridge Jnr (1902b).

Age: Early-early late Albian.

Aucellina cf. gryphaeoides (J. Sowerby), 1836

Pl.49, figs 1-2; pl.50, figs 8-25

Synonymy:

1884 Aucella liversidgei Etheridge Jnr, p.90, 2nd plate, top and lower right hand figures.

cf.1901 Aucellina gryphaeoides (J. Sowerby), Pompeckj; p.354 (synonymy), pl.16, figs 6-8.

cf.1902a Aucella incurva Etheridge Jnr, p.14, pl.7, figs 22-27.

cf.1905 Aucellina gryphaeoides (J. Sowerby); Woods, p.72 (synonymy), pl.10, figs 6-13.

cf.1907 Aucella incurva Etheridge Jnr, p.15.

cf.1928 Aucellina gryphaeoides (J. Sowerby); Whitehouse, p.278.

cf.1928 Aucellina incurva (Etheridge Jnr); Whitehouse, p.279.

cf.1958 Aucellina gryphaeoides (J. Sowerby); Glaessner, p.203, pl.24, fig.1a-b, text fig.2.

?1959b <u>Aucellina</u> sp. nov. E. cf. <u>A</u>. <u>incurva</u> (Etheridge Jnr); Brunnschweiler, p.18, text fig.5.

?1959b <u>Aucellina</u> sp. nov. F aff. <u>A</u>. <u>incurva</u> (Etheridge Jnr); Brunnschweiler, p.18, text fig.6.

cf.1959b <u>Aucellina</u> <u>incurva</u> (Etheridge Jnr); Brunnschwiler, p.13.

cf.1960 <u>Aucellina</u> <u>gryphaeoides</u> (J. Sowerby); Drushchitz & Kudryavtzev, p.180 (synonymy), pl.3, figs 12-16.

1966 <u>Aucellina</u> <u>gryphaeoides</u> (J. Sowerby); Ludbrook, p.155, pl.18, figs 4-6.

<u>Material</u>: About 5,000 separated right and left valves usually occurring in coquinas.

<u>Description</u>: Small to medium sized (length 3-25mm). Inequivalve. Left valve strongly inflated; larger than right valve. Right valve weakly or moderately inflated. Left valves erectly ovate; subequilateral; more-or-less acline. Mature forms not markedly produced postero-ventrally. Right valves suborbicular; subequilateral. Umbo of left valve high, narrow, rising above and over-hanging hinge line. Beak subcentral; sharply pointed; strongly prosogyral. Umbo of right valve broad. Beak small, strongly prosogyral. Left valve anterior ear small, some-times distorted and bent inwardly and ventrally. Anterior ear of right valve small, articulating beneath anterior ear of left valve; sometimes upturned and rising well

above hinge margin. Byssal notch wide, deep and crenulate. Interior of anterior ear of right valve hollowed out. Posterior ears of both valves small, well defined. Hinge line short. Hinge plate of left valve narrow, uncomplicated; inclined inwards, outwards or lying more or less within the plane of commissure. Hinge plate of right valve narrow, inclined outwards or set almost at right angles to the plane of commissure. Ligament pit of left valve basically triangular, transversely elongated, extending in front of and behind the umbo; anterior end of ligament pit subject to reduction or other modification in specimens with distorted anterior ears; posterior boundary of ligament pit a low, opisthocline ridge. Right valve ligament pit asymmetrically triangular; anterior boundary formed by the raised, posterior edge of the anterior ear; posterior boundary formed by the shelf-like junction of the hinge plate and the postero-dorsal margin of the shell. Musculature not observed. Umbonal region of left valves with strong radial ribs. Later parts of shell in both valves with fine, closely spaced concentric lamellae, and occasional very fine, subordinate, radial ribs.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Left valves				
CPC9273	22	7	24	-
CPC9272	13	6	15	8
CPC9856	12	5	12	5
CPC9855	10+	3.5	9+	5
CPC9854	9	4	12	6
CPC9863	8	3	-	5
CPC9869	c.8	-	c.9	-
CPC9857	6	2.5	9	4
CPC9853	6	3	8	4
CPC9858	5	2	6+	3
CPC9864	5	2.5	6	3
CPC9859	5	1.5	4	2
Right valves				
CPC9273	22	7	20	-
CPC9322	15	7	13	4
CPC9861	c.15	7	-	3
CPC9860	10	4	7+	3
CPC9862	7+	-	9	2

Remarks: Queensland specimens now compared with the long-ranging (Albian-Cenomanian), widely distributed, Boreal species *Aucellina gryphaeoides* (J. Sowerby), are distinguished from that form principally by their strong radial ornament on the umbonal region of left valves. They differ from those of A. hughendenensis (Etheridge Snr) in their reduced postero-ventral expansion and very feebly developed radial ornament on the rest of the shell.

Aucella liversidgei Etheridge Jnr (1884), described from "Landsborough Creek, a tributary of the Thomson River" and later referred to "Aucella" hughendenensis by its proposer, is now placed in synonymy with A. cf. gryphaeoides.

"Aucella" incurva Etheridge Jnr (1902a) from "Point Charles near Darwin" is closely related, but may not be conspecific as the exterior ornament of this form is not known. The type specimens of "A." incurva are refigured here (pl. 50, figs 1-7).

The hinge of the left valve of Aucellina cf. gryphaeoides has a transversely elongated, triangular ligament pit and is basically oxytomid like that of typical A. gryphaeoides. However, the anterior end of the hinge may be extensively modified in specimens with distorted anterior ears. In these, the anterior part of the ligament pit usually occupies a channel-like groove below the anterior ear. However, on one bizarre individual the ligament pit passes behind and outside the anterior ear.

Occurrence:

Allaru Mudstone: GAB821; GAB836; GAB854; GAB925?; GAB1041;

GAB1042; GAB1114; GAB1201; GAB1228; GAB1231; GAB1409?; GAB1416; GAB1419; GAB1610; GAB1611; GAB1612; GAB2067; GAB2068; GAB2070; BMR Longreach 2 (91'9"-162'5"); BMR Longreach 4 (91'3"-109'10").

Mackunda Formation: "Landsborough Creek" (Etheridge Jnr, 1884); GAB834; GAB853; GAB913; GAB1040; GAB1204; GAB1205?; GAB1210?; GAB1212; GAB1214?; GAB1219; GAB1224; GAB1302; GAB1304; GAB1311; GAB1312; GAB1324; GAB1325; GAB1332; GAB1335; GAB1336; GAB1360; GAB1367; GAB1368; GAB1403?; GAB1415?; GAB1417; GAB1420; GAB1423?; GAB1427?; GAB1429?; GAB1430; GAB1431?; GAB1500; GAB1502?; GAB1600?; GAB1607; GAB1616; GAB1619; GAB1721; GAB1930; GAB2040; BMR Longreach 2 (64'6"-71'10").

Maree Formation: Several localities reported by Ludbrook (1966).

Age: Early late Albian.

Genus *Maccoyella* Etheridge Jnr, 1892
(=*Mimetostreon* Bonarelli, 1921)

Type species (by original designation): *Avicula barklyi* Moore, 1870, Aptian, Eastern Australia.

Generic diagnosis: Small to very large. Thick or thin shelled. Pectinoid to gryphaeoid in shape. Inequilateral or equilateral. Inequivalve. Left valve moderately to strongly convex. Right valve flat, slightly concave or weakly convex; frequently smaller than left valve. Umbones subcentral to anterior. Umbo of left valve prominent; beak distinct or merging with hinge margin. Umbo of right valve small. Anterior ear of left valve crenulate. Anterior ear of right valve comparatively large, thickened, with a median central depression or socket on its interior edge. Byssal notch of right valve wide and deep, or narrow, channel-like and almost obsolete. Posterior ears large or small, not sharply defined from body of shell. Posterior border of posterior ears straight or sinuate. Hinge plate usually wide, bevelled steeply inwards in left valves less steeply inclined inwards in right valves. Lower margin of hinge plate in left valve immediately in front of umbo with a strong, knob-like "tooth" flanked by "sockets". Left valve "tooth" and "sockets" articulate with the median "socket" and raised margins of the right valve anterior ear. Ligament pit trapeziform; longitudinally striated; usually well excavated. Posterior adductor scars large, well impressed, subcircular, ovate, or bipartite. Pallial line remote from margins, formed by a discontinuous series of deep, elongate pits. Exterior ornamented with dense or sparse radial costae usually arranged in several orders. Left valves with fine, slightly imbricate, concentric lamellae, and sometimes with spinose radial ribs. Right valves with finer radial ribbing and concentric growth lines.

<u>Range</u>: Aptian - Albian.

<u>Remarks</u>: The diagnostic feature of the genus <u>Maccoyella</u> Etheridge Jnr (1892) is the strong, knob-like tooth of the left valve, which articulates with a median socket on the interior edge of the right valve anterior ear.

<u>Mimetostreon</u> Bonarelli (1921), proposed as a subgenus of <u>Gryphaea</u> and subsequently elevated to generic rank by Leanza (1963) (1967), is a subjective junior synonym of <u>Maccoyella</u>, as the type species by original designation, <u>Avicula</u> <u>corbiensis</u> Moore (1870) is a <u>Maccoyella</u>. Skwarko's (1966, p.176) remarks on the morphology of <u>Mimetostreon</u> are quite erroneous and should be disregarded. Also, as discussed in the section on "Overseas Correlations", the age of Argentinian form is Aptian not Albian as stated by Skwarko.

Etheridge Jnr (1892) considered that <u>Maccoyella</u> was closely allied to <u>Meleagrinella</u> Whitfield (1885). The writer shares this view. Externally, the two genera are very similar, though <u>Maccoyella</u> is usually larger and thicker shelled, while the hinge features are quite distinct (Fig.16). The hinge plate of <u>Maccoyella</u> is generally wide and is bevelled inwards in both valves, whereas in <u>Meleagrinella</u>, the hinge plate is narrow and is bevelled outwards in the right valve. In addition, the left valve tooth of <u>Maccoyella</u> is consistently stronger and more elevated than the bulbous, slightly more anteriorly placed, tooth-like thickening developed in some species of Meleagrinella, and the interior edge of the right valve anterior ear has a deep, median depression.

David & Browne (1950, p.498) stated that Maccoyella was descended from the Permian genus Eurydesma Morris. Waterhouse (1959, p.491) correctly discounted this proposal.

Dickins (1963, p.73) showed that the shell structure of Maccoyella was oxytomid. He thought that Maccoyella represented a specialized member of the Oxytomidae derived from Oxytoma. The two genera have similar exteriors, although Oxytoma is generally smaller, thinner shelled and has more emarginate, produced posterior ears. Apart from Borissjak (1909, pl.1, figs 3b-c, 4b, 5b, 8a-c) and Ichikawa (1958, pl.24, figs 1-7), few authors have provided good illustrations of the hinge of Oxytoma. Well preserved specimens of the type species of Oxytoma, O. munsteri (Bronn) were kindly loaned for study by the British Museum (Natural History). The hinges of these are identical with those figured by Borissjak (1909) and Ichikawa (1958). The hinge plate is comparatively narrow and lies more or less in the plane of commissure in the left valve and is bevelled outwards in the right valve. The lower margin of the hinge plate is very gently convex and is quite simple, the ligament pit is asymmetrically triangular, and the anterior ear of the right valve does not rise above the hinge line. Fig.16 shows that the hinge of _Maccoyella_ is more like that of _Meleagrinella_ than that of _Oxytoma_.

Exteriors of left valves of the Liassic-Valanginian genus _Arctotis_ Bodylevsky (1960) from Siberia, also resemble those of _Maccoyella_. However, the excellent figures of the left valve hinge of the type species of _Arctotis_, _Hinnites lenaensis_ Lahusen, given by Borissjak (1915, pl.11, figs 7-9), reveal a wide hinge plate with a trapeziform ligament pit, but lacking the anterior "tooth" of _Maccoyella_. Right valves of _Arctotis_ have larger anterior ears and wider byssal notches.

Malayomaorica, proposed by Jeletzky (1963) for _Aucella malayomaorica_ Krumbeck from the Upper Jurassic of Indonesia and New Zealand, has a wide hinge plate and a trapeziform ligament pit (Jeletzky, 1963, pl.21, figs 1B, 1D, 1G, 1F), but the tooth-like bulge of the left valve is much weaker and differently placed to that of _Maccoyella_. Furthermore, the exterior ornament of _Malayomaorica_ is much finer and the right valve anterior ear and byssal notch are quite different.

Some species of _Maccoyella_, e.g. _M. barklyi_ (Moore), have a well developed byssal notch and were probably attached forms. Large species such as _M. reflecta_

(Moore) and M. umbonalis (Moore) were probably free living forms (anchored by their weight), as their byssal notches are virtually obsolete. Dickins (1963, p.75) previously reached this conclusion. Spines on left valves probably assisted in stabilizing individuals on the sea floor.

Maccoyella is represented in Australia by 10 Aptian and 3 Albian species. Aptian species are M. barklyi (Moore, 1870), M. reflecta (Moore, 1870), M. umbonalis (Moore, 1870), M. subangularis Etheridge Jnr (1892), M. corbiensis (Moore, 1870), M. gibbosa (Etheridge Snr, 1872), M. rostrata Etheridge Jnr (1901), M. simplex (Moore, 1870), M. neocomiana Skwarko (1966) (=M. mullamanensis Skwarko, 1966 and M. transitoria Skwarko, 1966). Albian species are M. rockwoodensis (Etheridge Jnr, 1892), M. allaruensis sp. nov. and M. muttaburraensis sp. nov. At present there are no described species of definite Neocomian age. Skwarko (1966) assigned a late Neocomian age to his new species, but they are here regarded as early Aptian species. In New Zealand, Maccoyella is represented by the Australian Aptian species M. reflecta (Moore, 1870) (=M. magnata Marwick, 1939), M. incurvata Waterhouse (1959) of possible Aptian age, and unnamed species of possible Albian age. Maccoyella also occurs in Patagonia, where it is represented by a single Aptian species, M. bonarellii (Leanza, 1963; 1967).

Maccoyella barklyi (Moore), 1870

Pl.51, figs 1-8; pl.52, figs 1-2; text fig.16G,H,I

Synonymy:

1870 Avicula barklyi Moore, p.245, pl.11, figs 1-2.

1872 Streptorhynchus davidsoni Etheridge Snr, p.333, pl.17, fig.1.

1880 Monotis barklyi (Moore); Tate, p.104.

1882 Avicula barklyi Moore; Tate, p.149.

1885 Monotis barklyi (Moore); Tate, p.76.

1887 Monotis barklyi (Moore); Tate, p.53.

1889 Avicula barklyi (Moore); Tate, p.230.

1892 Maccoyella barklyi (Moore); Etheridge Jnr, p.455, pl.22, figs 1,2,4,5.

1892 Maccoyella reflecta (Moore)?; Etheridge Jnr, pl.23, figs 1-2 only.

1892 Maccoyella barklyi (Moore) var. mariaeburiensis Etheridge Jnr, p.563, pl.22, fig.3 only.

1901 Avicula barklyi Moore; Guerich, p.484.

1902a Maccoyella barklyi (Moore); Etheridge Jnr, p.11, pl.1, figs 3-6.

1902b Maccoyella barklyi (Moore); Etheridge Jnr, p.17, pl.1, figs 3,4; pl.2, figs 3-5; pl.3, figs 4,5; pl.4, figs 3,4.

1902 Maccoyella barklyi (Moore) Etheridge Jnr & Dun, p.72.

1915 Maccoyella barklyi (Moore); Newton, p.225, pl.6, fig.19.

1925 Maccoyella barklyi (Moore); Whitehouse, p.28.

1927 Maccoyella barklyi (Moore); Whitehouse, p.145-146.

1928 Maccoyella barklyi (Moore); Whitehouse, p.276-277.

1960 Maccoyella barklyi (Moore); Day, p.311.

1961 Maccoyella barklyi (Moore); Woods, p.6 only.

?1961 Maccoyella aff. barklyi (Moore); Cox, pl.16, pl.1, fig.14.

1964 Maccoyella barklyi (Moore); Day, p.17-18, table 3.

1965 Maccoyella barklyi (Moore); Day, p.418.

1966 Maccoyella barklyi (Moore); Ludbrook, p.150, pl.15, figs 1-7.

1967b Maccoyella barklyi (Moore); Day, p.21, pl.5, figs 18-19; pl.6, figs 4-7.

Types: Avicula barklyi Moore. Holotype: Lost.

Locality: "Wollumbilla", Doncaster Member, upper Aptian.

Neotype: (now selected) F35503 UQ, a large well preserved topotype with valves in apposition. Locality: RD122, Doncaster Member, upper Aptian.

Streptorhynchus davidsoni Etheridge Snr.

Holotype: F1236 QM. Locality: "Walsh River"?, Blackdown Formation, upper Aptian. Etheridge Snr (1872) gave the locality as "Bowen River". This is certainly incorrect. According to the museum label the specimen is from "Walsh River". This may be correct as the matrix and preservation matches that of other Walsh River material.

Maccoyella *barklyi* var. *mariaeburiensis*

Etheridge Jnr. Lectotype: (now selected) F1415 GSQ, the specimen figured by Etheridge Jnr (1892, pl.22, fig.3). Locality: "Maryborough", Maryborough Formation, Aptian.

Material: About 200 specimens, mostly preserved with valves separated.

Specific diagnosis: Equilateral, pectinoid shaped *Maccoyella*; height greater than length; posterior ears small, with straight posterior borders; ornament multicostate; left valves with radial ribs arranged in several distinct orders; primary radial ribs, spinose, 10-12 in number; finer secondary, tertiary and occasionally quaternary radial ribs first intercalated about 5mm, 20mm and 40mm below the umbo respectively; right valve with numerous, closely spaced radial ribs, not arranged in distinct orders; dorsal parts of posterior ears of both valves without radial ribs.

Description: Small (length 10mm) to large (length 100mm); generally medium to large in size. Thick shelled. Equilateral; pectinoid; higher than long. Inequivalve. Left valve moderately inflated; larger than right valve. Right valve flat. Dorsal margin slightly greater than half shell length. Antero-dorsal margin of left valve very crenulate. Antero-dorsal margin of right valve almost straight, steeply sloping. Postero-dorsal margin straight, short. Other margins broadly rounded. Left valves with a variably developed postero-ventral sulcus. Umbones subcentral. Umbo of left valve broad, prominent, rising above hinge line; beak not sharply defined from hinge margin. Umbo of right valve small, insignificant. Left valve anterior ear large, highly crenulate. Right valve anterior ear large, thickened, separated from the body of shell by a wide, deep, byssal notch. Interior edge of right valve anterior ear with a deep median depression or socket. Posterior ears small, larger in the right valve than in the left valve. Posterior border of posterior ear almost straight; forming an angle of 110° with the hinge margin in juvenile specimens, and an angle of about 140° in adult specimens. Hinge plate wide, thick, bevelled steeply inwards in left valve; bevelled gently inwards in right valve. Lower margin of hinge plate almost immediately below the umbo of left valve, with a strong, knob-like "tooth" flanked by depressions or sockets. Left valve "tooth" articulates with the median depression or socket on the interior edge of the right valve. Ligament pit trapeziform, well excavated, longitudinally striated. Ligament pit in left valve bounded anteriorly by a low, slightly opisthocline ridge originating at the umbo;

posterior termination a faint, very opisthocline ridge. Ligament pit in right valve bounded anteriorly by the opisthocline, raised posterior edge of the anterior ear; posterior boundary a prominent, very opisthocline fold. Posterior adductor scars in both valves large, well impressed, with concentric lines marking successive growth stages. Posterior adductor scar situated at about mid-height and just behind mid-length. Pallial line very remote from margins, formed by a series of deep, elongate, discontinuous pits, extending from the anterior side of the umbonal cavity to the posterior adductor scar. Ornament of left valve consisting of fine, closely spaced, slightly imbricate concentric lamellae, numerous (30-45 at shell height of approx. 50mm) radial ribs arranged in several distinct orders, and widely spaced concentric depressions marking growth halts. Intercalation of radial ribs as per specific diagnosis. Radial ribbing interrupted, and sometimes offset by periodic, prominent concentric depressions. Right valve with fine concentric growth lines, very numerous (40-60 at shell height of approx. 50mm), low, fine radial ribs arranged in several not readily distinct orders, and widely spaced concentric depressions marking growth halts.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
F35503 UQ	80	38	90	44	22	30
F35502 UQ	50	24	50+	32	14	18
F35504 UQ	78	39	88	44	20	22 (left valve)
F35501 UQ	58+	-	60	40	18	8 (right valve)
CPC9278	72	35	78	45	22	18 (left valve)

Remarks: The holotype of Avicula barklyi Moore (1870, p.245, pl.11, figs 1-2) from "Wollumbilla" was destroyed by fire in Sydney in 1882. The neotype (F35503 UQ) now selected from topotypic material has closed valves and closely resembles the form figured by Moore. Other topotypes clearly show the hinge and internal features.

At RD122 apparently undisturbed specimens of Maccoyella barklyi have been found lying on the convex left valve in thin beds of fine grained, silty sandstone. The species may have been stabilized by spines and possibly attached by a byssus, as the byssal notch is quite wide.

Whitehouse (1928) thought that the interpolation of the higher orders of radial ribs in Maccoyella barklyi, and also in M. corbiensis, was a mutant condition. Day (1967b, p.22) after study of a large number of left valves concluded that the interpolation of tertiary and quaternary radial ribs was a function of increasing size. Contrary to the claims of Whitehouse (1927) (1928), no biostratigraphic significance may be attached to rib development.

Primary radial ribbing varies in strength. A specimen from "Maryborough" with very strongly developed, spinose primary radial ribs was described by Etheridge Jnr (1892, pl.22, fig.3) as *Maccoyella barklyi* var. *mariaeburiensis*. This specimen (F1415 GSQ) is now designated lectotype of *mariaeburiensis*. Other specimens from "Croydon" (Gilbert River Formation) are conspecific with *Maccoyella neocomiana* Skwarko (1966, p.77, pl.5, figs 14-17).

Specimens reported by Woods (1961, p.2) from the Wrotham Park Sandstone as *Maccoyella barklyi*, belong to *M. neocomiana*.

A single, small left valve described from the Nanutarra Formation by Cox (1961, p.16, pl.1, fig.14) as *Maccoyella* aff. *barklyi* (Moore) may be a representative of *M. barklyi*.

Maccoyella barklyi (Moore) is distinguished from *M. reflecta* (Moore, 1870, p.246, pl.12, fig.1) by its shorter hinge line, smaller posterior ear, and generally by its stronger, more spinose radial ribs.

Occurrence:

Minmi Member: "Blythesdale Station, between Wallumbilla and Roma" (Etheridge Jnr, 1892); "Portion 13, parish Euthulla"; "portion 131V, parish Bungeworgorai" (Whitehouse, 1927); RD78; RD94?; RD99; RD107; RD207?; RD285?; L139 GSQ; L140 GSQ; L141 GSQ; L272 GSQ; GAB1942; GAB2168; SB107; SB118.

Doncaster Member: "Wollumbilla" (Moore, 1870); "Bungeworgorai Creek near Mt Abundance"; "Maranoa River at Mitchell" (Etheridge Jnr, 1892); "Gammies Plains"; "Roma Downs Homestead (portion 4)"; "Roma Downs (Portion 9)"; "Bindango"; "Portion 167V, parish of Beaufort" (Whitehouse, 1927); RD5; RD46; RD91?; RD92; RD117; RD121; RD194; RD210; RD221; RD222; L92 GSQ; L98 GSQ; L99 GSQ; L102 GSQ; L108 GSQ; L156 GSQ; GAB870; GAB884; GAB1036; GAB1115; GAB1134; GAB1384; GAB1831; GAB1887?; GAB2098; GAB2123; GAB2155; GAB2163; GAB2166; GAB2169; SB106?; SB110; SB125; SB129.

Blackdown Formation: "Walsh River" (Etheridge Jnr, 1892) and several localities reported by Woods (1961).

Maryborough Formation: "Maryborough" (Etheridge Jnr, 1892).

Maree Formation: Several localities reported by Etheridge Jnr (1902a) and Ludbrook (1966).

N.S.W.: Several localities in north-west N.S.W. reported by Etheridge Jnr (1902b).

W. Aust.: ? Nanutarra Formation (Cox, 1961).

Age: Early - late Aptian.

Maccoyella reflecta (Moore), 1870

Pl.52, figs 7-8; pl.53, figs 1-2; pl.55, fig.5; pl.58, fig.8

Synonymy:

1870 Avicula reflecta Moore, p.246, pl.12, fig.1.

1883a Avicula barklyi vel reflecta Moore var. gilliatti Tenison Woods, p.240, pl.12, figs 4-5, ? 6.

1892 Maccoyella reflecta (Moore); Etheridge Jnr, p.457; p.564, pl.23, figs 3,5,6,7 only.

1892 Maccoyella reflecta var. gilliatti Tenison Woods; Etheridge Jnr, pl.23, fig.10.

1902b Maccoyella reflecta (Moore); Etheridge Jnr, p.18, pl.1, figs 1-5; pl.2, figs 1-2; pl.3, figs 1-3; pl.4, fig.2.

1902 Maccoyella reflecta (Moore); Etheridge Jnr & Dun, p.72.

1939 Maccoyella magnata Marwick, p.462, pl.61, figs 1-2.

1959 Maccoyella magnata Marwick; Waterhouse, p.497, figs 19-21.

1964 Maccoyella reflecta (Moore); Day, p.18, table 3.

1965 Maccoyella reflecta (Moore); Day, p.418-419.

1966 Maccoyella reflecta (Moore); Ludbrook, p.152, pl.15, fig.8?, fig.9.

1967 Maccoyella sp. cf. M. reflecta (Moore); Skwarko, p.15, pl.1, figs 6-8.

Type: Holotype: Lost. Locality: "Wollumbilla", Doncaster Member, upper Aptian. Neotype: (now selected) CPC9242, a large well preserved topotype with valves in apposition. Locality: SB121, Doncaster Member, upper Aptian.

Material: About 50 specimens with closed valves and a few left valves.

Specific diagnosis: Equilateral pectinoid shaped Maccoyella; length greater than height; posterior ears large, obtusely rounded; ornament multicostate; left valves with 18-20, sometimes spinose, primary radial ribs; secondary, tertiary and quaternary radial ribs first intercalated about 5mm, 15mm and 40mm below the umbo respectively; right valves with about 30 primary radial ribs; secondary, tertiary, and quaternary radial ribs first intercalated about 10mm, 25mm and 40mm below the umbo respectively.

Description: Medium to large in size (length 50-100mm). Thick shelled. Equilateral; pectinoid; length greater than height. Inequivalve. Left valves weakly convex. Right valves flat. Dorsal margins long, almost straight anteriorly and posteriorly; forming an angle of about 150° at the umbo in left valve and about 160° at the umbo of right valve. Other margins gently convex. Umbones subcentral. Umbo of left valve broad, not inrolled; beak distinct from hinge margin. Umbo of right valve small. Left valve anterior ear large, crenulate. Right valve anterior ear large, thickened, separated from body of shell by a channel-like, byssal notch. Interior surface of right valve anterior ear not observed. Posterior ears in both valves very large, not sharply defined, obtusely rounded. Hinge plate wide and thick; bevelled inwards in both valves. Lower margin of hinge plate immediately in front of umbo of left valve with a strong, knob-like "tooth" flanked by "sockets". Ligament pit in left valve trapezoidal, deeply excavated, longitudinally striated. Anterior boundary of ligament pit in left valve a strong, slightly opisthocline ridge originating at the umbo; posterior termination a very opisthocline ridge. Ligament pit in right valve incompletely exposed; anterior boundary formed by the opisthocline, raised edge of the anterior ear; posterior termination not exposed. Adductor scars and pallial features not observed. Left valves ornamented with fine, closely spaced, slightly imbricate concentric lamellae, widely spaced depressions marking growth halts, and numerous radial ribs arranged in several orders (32-75 ribs at shell height approx. 50mm). Intercalation of radial ribs as per specific diagnosis. Right valves ornamented with fine concentric growth lines, widely spaced concentric depressions marking major growth halts, and numerous, low radial ribs arranged in several orders (70-100 ribs at shell height approx. 50mm). Radial ornament interrupted and frequently offset by concentric depressions; posterior ears in both valves with radial ribs.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
CPC9242	120	51	100	55	14	30
CPC9279	88	43	79	57	17	14
CPC9277	60	28	50	42	17	15 (left valve)
F35526 UQ	58	27	54	31	12	12 (" ")
F6053 GSQ	c.63	27	c.58	c.31	12	-

Remarks: The type specimen of Avicula reflecta Moore (1870, pl.12, fig.1) from "Wollumbilla" was inadequately figured. It was destroyed by fire in Sydney in 1882. The neotype (CPC9242) now selected from topotypic material closely resembles specimens figured by Etheridge Jnr (1892, pl.23, figs 3, 5-7) (1902b, pl.1, figs 1-5; pl.2, figs 1-2; pl.3, figs 1-3; pl.4, fig.2) as Maccoyella reflecta (Moore). However, a specimen (F1294 GSQ) figured by Etheridge Jnr (1892, pl.23, figs 1-2) as Maccoyella reflecta (Moore) ? belongs to M. barklyi (Moore).

Maccoyella reflecta (Moore) is allied to M. barklyi (Moore, 1870), but is distinguished by its longer hinge line and larger posterior ear.

Maccoyella reflecta is also very closely related to, and may be conspecific with, M. umbonalis (Moore, 1870) as their principal difference is size. However, the two are provisionally separated as the anterior boundary of the ligament pit in left valves to *M. umbonalis* is placed more anteriorly than that of *M. reflecta*, and the primary radial ribs of *M. umbonalis* appear to be non-spinose.

Waterhouse (1959, p.499) considered *Maccoyella magnata* Marwick (1939, p.462, pl.61, figs 1-2) from the Korangan Stage (= Aptian) of New Zealand (Wellman, 1959) a possible synonym of *M. reflecta* (Moore). Dr I.G. Speden of the New Zealand Geological Survey has kindly furnished for study a plaster cast of the holotype and only known specimen (TM2121). This closely corresponds to specimens of *M. reflecta* in size, hinge features and in radial ribbing. The New Zealand specimen, as far as can be ascertained, is also similar in shape, although much of the posterior ear appears to be missing. *Maccoyella magnata* is therefore considered to be a junior synonym of *M. reflecta*.

Occurrence:

Doncaster Member: "Wollumbilla" (Moore, 1870); "Bungeworgorai Ck near Mt Abundance" (Etheridge Jnr, 1892); RD90; L155 GSQ; L156 GSQ; GAB870; GAB1116; GAB1117; GAB1118; GAB1135; GAB1137; GAB1800; SB105; SB116; SB121.

Jones Valley Member: GAB1139; GAB1140.

Maryborough Formation: "Isis River near Maryborough and Bundaberg Road" (Etheridge Jnr, 1892).

Maree Formation: Tieyon 5/497/1 and Toodina 5/570/12 (Ludbrook, 1966).

N.S.W.: Several localities reported by Etheridge Jnr (1902b).

W. Aust.: Gibson Desert (Skwarko, 1967).

Age: Late Aptian.

Maccoyella umbonalis (Moore), 1870

Pl.54, fig.6; pl.56, fig.1; pl.57, fig.1

Synonymy:

1870 Avicula umbonalis Moore, p.246, pl.12, figs 2-3.

1889 Avicula umbonalis Moore; Tate, p.230.

1892 Maccoyella umbonalis (Moore); Etheridge Jnr, p.458, p.564, pl.22, figs 6-7, pl.23, fig.4.

1901 Maccoyella umbonalis (Moore); Etheridge Jnr, p.16.

1902a Maccoyella umbonalis (Moore); Etheridge Jnr, p.13, pl.1, fig.8.

1902b Maccoyella umbonalis (Moore); Etheridge Jnr, p.20, pl.4, fig.1.

1902 Maccoyella umbonalis (Moore); Etheridge Jnr & Dun, p.72.

1964 Maccoyella umbonalis (Moore); Day, table 3.

1966 Maccoyella umbonalis (Moore); Ludbrook, p.152.

Type: Holotype: Lost. Locality: "Wollumbilla", Doncaster Member, upper Aptian. Neotype: (now selected) F35515 A/B UQ, a large specimen with valves in apposition. Locality: RD90, Doncaster Member, upper Aptian.

Material: Five left valves and ten specimens with closed, undisturbed valves.

Specific diagnosis: Very large, very thick shelled, subequilateral, pectinoid shaped Maccoyella; posterior ears large, obtusely rounded; ornament multicostate, non-spinose; several orders of radial ribs present but not readily distinguished.

Description: Very large (length 100-200mm). Very thick shelled. Sub-equilateral; pectinoid; length greater than height. Inequivalve. Left valves weakly convex. Right valves flat. Dorsal margins almost straight anteriorly and posteriorly, forming an angle of about 160° at the umbo. Other margins gently convex. Umbones slightly posterior. Umbo of left valve broad, not inrolled, Umbo of right valve small, flattened. Left valve anterior ear comparatively small, crenulate. Right valve anterior ear large, thickened, separated from the body of the shell by a channel-like, almost obsolete byssal notch. Interior edge of right valve anterior ear with a knob-like thickening at its anterior and posterior extremities, and a subcentral ridge flanked by depressions; posterior depression larger and deeper than anterior depression. Posterior ears of both valves large, not sharply defined. Posterior border of posterior ear forming an angle of about 140° with the hinge margin. Hinge plate very wide and thick, bevelled inwards in both valves. Lower margin of hinge plate of left valve immediately in front of umbo with a very large, knob-like "tooth" flanked by "sockets". Left valve "tooth" and "sockets" articulate with the "teeth" and "sockets" on the inner edge of the right valve anterior ear. Ligament pit in both valves subrhomboidal, deeply excavated, longitudinally striated. Anterior boundary of ligament pit in left valve a sharp, slightly opisthocline fold, situated just in front of the umbones; posterior termination opisthocline, not as distinct as anterior boundary. Anterior boundary of ligament pit in right valve formed by the raised, slightly opisthocline edge of the anterior ear; posterior termination prominent, slightly more opisthocline than anterior boundary. Posterior adductor scars in both valves large, well impressed with crescentic lines marking successive growth stages. Adductor scar situated at mid-height and slightly posterior of mid-length. Pallial line remote from margins, formed by a series of deep, discontinuous pits, extending from the anterior side of the umbonal cavity to the posterior adductor scar. Ornament not well preserved. Both valves with fine concentric growth lamellae and numerous, fine, non-spinose radial ribs of several orders; primary, secondary and later radial ribs not strongly differentiated.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
F35515 A/B UQ	175	95	165	125	60	40
CPC9280	140	75	112	100	45	34

Remarks: Moore's type specimen from "Wollumbilla" was destroyed by fire in Sydney in 1882. The neotype now selected is from RD90, a locality some 30 miles west of "Wollumbilla", but on approximately the same stratigraphic horizon.

Maccoyella umbonalis (Moore, 1870, pl.12, figs 2-3) is closely related to M. reflecta (Moore, 1870, pl.12, fig.1) and the former may represent the gerontic stage of the latter species. However, as discussed in the preceding section, the two are provisionally separated.

The enormous size coupled with the almost obsolete condition of the byssal notch suggest that _M. umbonalis_ was a free living, epifaunal species.

Occurrence:

Doncaster Member: "Wollumbilla" (Moore, 1870); "Bungeworgorai Creek near Mt Abundance" (Etheridge Jnr, 1892); RD90; RD122; RD124?; RD221; RD222; GAB883; GAB1137; SB116.

Jones Valley Member: GAB1139.

Maryborough Formation: "Corporation Quarry, Maryborough"; "Wharf railway, Maryborough" (Etheridge Jnr, 1892).

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a) and Algebuckina 5/571/5 (Ludbrook, 1966).

N.S.W.: "near Milparinka, north-west N.S.W." (Etheridge Jnr, 1902b).

Age: Late Aptian.

Maccoyella subangularis Etheridge Jnr, 1892

Pl.52, figs 5-6

Synonymy:

1870 _Avicula substriata_ Moore, p.247, pl.11, fig.6, _non_ Zeiten, 1830.

1892 Maccoyella ? substriata (Moore); Etheridge Jnr, p.459, pl.22, fig.10 only.

1892 Maccoyella subangularis Etheridge Jnr, p.460.

1901 Maccoyella substriata (Moore); Etheridge Jnr, p.19, pl.3, fig.5; pl.4, fig.4.

1901 Maccoyella ? subangularis Etheridge Jnr, p.19.

1902a Maccoyella barklyi (Moore); Etheridge Jnr, pl.1, fig.7 only.

1902 Maccoyella substriata (Moore); Etheridge Jnr & Dun, p.72.

1927 Maccoyella substriata (Moore); Whitehouse, p.146.

1928 Maccoyella substriata (Moore); Whitehouse, p.277

1964 Maccoyella subangularis Etheridge Jnr; Day, table 3.

1967b Maccoyella subangularis Etheridge Jnr; Day, p.22, pl.5, figs 1-3.

Types: Avicula substriata Moore. Holotype: Lost. Locality: "Wollumbilla". Doncaster Member, upper Aptian.

Maccoyella subangularis Etheridge Jnr. Holotype: Lost. Locality: "Bungeworgorai Creek, near Mt Abundance", Doncaster Member, upper Aptian. Neotype: (now selected) F35516 UQ, a small topotypic left valve. Locality: RD90, Doncaster Member, upper Aptian.

Material: Fifteen separated left and right valves.

Specific diagnosis: Small, thin shelled, inequilateral pectinoid shaped Maccoyella; posterior ears large; hinge plate narrow; ornament multicostate; left valve with up to 12, comparatively strong, spinose, primary radial ribs; secondary, tertiary and quaternary radial ribs first intercalated 5mm, 10mm and 20mm below the umbo respectively; right valves with numerous, closely spaced radial ribs, not strongly differentiated into orders; posterior ears of both valves bearing radial ribs.

Description: Small (length 10-30mm). Thin shelled. Inequilateral. Somewhat elongate-oblong in shape. Inequivalve. Left valve moderately convex. Right valve very weakly convex. Dorsal margins long and straight, forming almost two-thirds of shell length; meeting at the umbo at almost 180°. Posterior margin very gently convex. Anterior and ventral margins broadly rounded. Umbones situated in anterior two-fifths of shell. Umbo of left valve broad, prominent, rising above hinge margin; beak distinct. Umbo of right valve small, insignificant. Left valve anterior ear crenulate, with a raised anterior border. Right valve anterior ear small, separated from body of shell by a narrow, byssal notch. Posterior ears of both valves large and expanded, with little or no emargination. Hinge of right valve not observed. Hinge plate of left valve narrow, bevelled inwards; lower margin of hinge plate immediately in front of umbo with a small, knob-like, "tooth", flanked by shallow sockets. Ligament pit small, somewhat trapeziform;

elongated postero-ventrally; longitudinally striated. Anterior boundary of ligament pit a slightly opisthocline ridge originating at the umbo; posterior termination faint, very opisthocline. Musculature and pallial features of right valve not observed. Posterior adductor scar of left valve small, sub circular, dorsally situated. Pallial line remote from margins, formed by a series of deep, discontinuous pits. Left valves ornamented with delicate, closely spaced, slightly imbricate concentric lamellae, and numerous (30-40 at shell height approx. 20mm) fine radial ribs arranged in several orders. Intercalation of radial ribs as per specific diagnosis. Right valve with numerous (about 50 at shell height approx. 20mm), very fine radial ribs, not strongly differentiated into orders, and fine concentric growth lines.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
F35516 UQ	28	12	23	20	6	6 (left valve)
F35506 UQ	23+	10+	17+	15+	7	5 (" ")
F7843 GSQ	25	11	19.5	18	9	2 (right valve)

Remarks: Maccoyella subangularis, a name applied by Etheridge Jnr (1892, p.460) to an unfigured specimen collected from "Bungeworgorai Creek near Mt Abundance" by George Sweet, was subsequently listed by Etheridge Jnr (1901, p.19) as a synonym of Avicula substriata Moore (1870, p.247, pl.11, fig.6). As Moore's name is preoccupied, Etheridge's becomes the first available. The type of Moore's species was destroyed by fire in Sydney in 1882. The type of Etheridge's species is apparently also lost, as I was unable to locate the form in the Sweet collection of the National Museum of Victoria. The neotype (a left valve F35516 UQ) now selected from topotypic material compares closely with the left valve illustrated by Moore (1870, pl.11, fig.6).

Maccoyella reflecta (Moore, 1870) resembles *M. subangularis* in outline and ornament, but the former is larger, thicker shelled, and is more equilateral.

Except for the well developed, knob-like *Maccoyella* "tooth", the narrow hinge plate of the left valve of *M. subangularis* is very like that of some species of *Meleagrinella*.

Occurrence:

Minmi Member: "Por. 115v, par. Bungeworgorai" (Whitehouse, 1927); RD6; RD26; RD109?; RD128; L2162 UQ; SB226; SB228.

Doncaster Member: "Wollumbilla" (Moore, 1870); "Bungeworgorai Creek near Mt Abundance" (Etheridge Jnr, 1892); RD90; RD122; SB129; BMR Richmond 1 (154'7" - 154'9")?; BMR Richmond 2 (75'2" - 75'2½").

Maryborough Formation: "Corporation Quarry, Maryborough" (Etheridge Jnr, 1901).

Maree Formation: "Lake Eyre Basin" (Etheridge Jnr, 1902a).

Age: Early - late Aptian.

<u>Maccoyella</u> <u>allaruensis</u> sp. nov.

Pl.52, figs 3-4; pl.54, figs 1-5

<u>Types</u>: <u>Holotype</u>: ANU17900, a left valve. <u>Paratypes</u>: CPC9281, CPC9282 and CPC9284, left valves; CPC9283, a right valve; ANU17901, a specimen with valves in apposition. <u>Locality</u>: Holotype and ANU17901, Tributary of Brutus Creek, about 1 mile S.E. of "Currane" (grid ref. 260083 Longreach 1:250,000 sheet); CPC9281, GAB1610; CPC9282, GAB1611; CPC9283, GAB1612; CPC9284, GAB1085. All specimens from the Allaru Mudstone, lower upper Albian.

<u>Material</u>: Eight left valves, a single right valve and a specimen with valves in apposition.

<u>Specific diagnosis</u>: Medium sized, inequilateral pectinoid shaped <u>Maccoyella</u>; posterior ears large; posterior ear of left valve produced with a deeply sinuate posterior border; ornament of left valve multicostate, non-spinose, comprising several weakly differentiated orders of radial ribs; primary radial ribs fine, about 10 in number; secondary, tertiary and quaternary radial ribs intercalated about 8mm, 20mm, and 30mm below the umbo respectively; radial ornament on right valves sparse, consisting of 5, prominent, widely spaced, radial ribs, and much finer, secondary and tertiary radial ribs first intercalated about 10mm and 15mm below the umbo; posterior ears in both valves without radial ornament.

<u>Description</u>: Medium sized (length 30-60mm). Thick-shelled. Inequilateral. Pectinoid shaped; length greater than height. Inequivalve. Left valve moderately inflated. Right valve concave. Hinge line long

and straight; about two-thirds shell length. Posterior margin of right valve and posterior margin of left valve below posterior ear almost straight. Antero-dorsal margin of right valve almost straight, steeply sloping. Antero-dorsal margin of left valve concave. Other margins gently convex. Umbones situated in about the anterior two-fifths of shell. Umbo of left valve, broad, not inrolled; beak distinct from hinge margin. Umbo of right valve small, insignificant. Anterior ear of left valve small, crenulate. Anterior ear of right valve large, thickened, separated from the body of shell by a narrow, channel-like, byssal notch. Interior edge of right valve anterior ear with a median depression. Posterior ears in both valves large, not sharply defined from body of shell. Posterior ear of left valve produced, with a strongly sinuate posterior border; produced portion of ear sometimes not preserved. Right valve posterior ear forming an angle of about 110° with the hinge margin. Hinge plate comparatively narrow, bevelled inwards in both valves. Hinge features as for genus. Ligament pit trapeziform, well excavated. Ligament pit in left valve bounded anteriorly by a low, slightly opisthocline ridge originating at the umbo; posterior termination a faint very opisthocline ridge. Anterior boundary of ligament pit of right valve formed by the opisthocline, raised anterior edge of anterior ear; posterior termination very opisthocline. Adductor muscle scars and pallial features of right valve not observed. Left valve with a small, sub circular, well impressed, very dorsally situated, posterior adductor scar. Pallial line very remote from margins; formed by a series of deep, elongate almost continuous pits extending from the umbonal cavity to the posterior adductor scar. Left valves with delicate, closely spaced (about 5 per mm), slightly imbricate concentric lamellae, and numerous (approx. 55 at shell height 35mm), closely spaced, non-spinose radial ribs, and widely spaced concentric depressions marking growth halts. Radial ribs weakly differentiated into several orders. Intercalation of radial ribs as per specific diagnosis. Radial ribs interrupted, but not offset at growth halts. Right valves ornamented with fine, concentric growth lines and sparse radial ribs (about 30 ribs at shell height 30mm). Intercalation of radial ribs of right valve as per specific diagnosis.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
ANU17900	45	21	37	28	5	10 (left valve)
CPC9281	45	18	36	30	5	12 (" ")
CPC9282	31+	-	26	23+	-	8 (" ")
CPC9284	69	33	68	28+	7	20 (" ")
CPC9283	32	12	28	20	5	3 (right valve)
ANU17901	70	24	64	30+	8	20 (both valves)

Remarks: The left valve of Maccoyella allaruensis sp. nov. has a produced posterior ear like that of M. rockwoodensis. However, left valves of the former species are longer than high, are generally larger, and the radial ribs of M. allaruensis (about 40 at shell height 25mm) are more numerous than those of M. rockwoodensis (20-25 at shell height 25mm). The right valve of M. allaruensis approaches that of M. rockwoodensis in shape, but the radial ribs of the former, though sparse (about 20 at shell height 15mm), are about twice as numerous as those of the latter species (about 10 at shell height 15mm).

The Aptian species Maccoyella reflecta (Moore, 1870), which has a similar long hinge line and somewhat similar radial ornament on the left valve, is distinguished by its more equilateral form and non-emarginate, left valve posterior ear. In addition, the right valve of M. reflecta has many more radial ribs (50-60 at shell height 30mm) than that of M.allaruensis (30 ribs at shell height 30mm).

Maccoyella allaruensis has been found only in the Allaru Mudstone of the Longreach and Muttaburra areas, where it is associated with species of the Albian ammonites Beudanticeras, Myloceras and Labeceras.

Occurrence:

Allaru Mudstone: GAB1085; GAB1610; GAB1611; GAB1612; GAB2104?

Age: Early late Albian.

Maccoyella muttaburraensis sp. nov.

Pl.58, figs 19-23

Types: Holotype: CPC9285, a left valve. Paratypes: CPC9286 and CPC9324, left valves; CPC9287 and CPC9325, right valves. Locality: Holotype, CPC9324 and CPC9325, GAB1336; CPC9286, GAB1254; CPC9287, GAB812. All specimens from the Mackunda Formation, lower upper Albian.

Material: About 50 separated right and left valves.

Specific diagnosis: Thin shelled, equilateral, pectinoid shaped M ccoyella; height and length approximately equal; posterior ears small; ornament multicostate in both valves; left valve with about 15 strong, spinose, primary radial ribs; secondary, tertiary and occasionally quaternary ribs first intercalated 2-3mm, 5mm and about 10mm below the umbo respectively; right valve with very numerous, low radial ribs not arranged in distinct orders; posterior ears of both valves bearing radial ribs.

Description: Small to medium sized (length 10-50mm). Thin shelled. Equilateral. Pectinoid shaped; height and length approximately equal. Inequivalve. Left valve moderately inflated. Right valve weakly inflated. Anterior and posterior dorsal margins of left valves short, straight; meeting at the umbo at almost 180°. Antero-dorsal margin of right valve almost straight. Postero-dorsal margin short, straight, forming an angle of about 150° at the umbo. Posterior margin convex below posterior ear. Other margins broadly rounded. Umbones subcentral. Umbo of left valve broad, rising slightly above hinge margin. Umbo of right valve small. Anterior ear of left valve crenulate, with a raised anterior border. Anterior ear of right valve small; separated from body of shell by a deep, byssal notch. Posterior ears of both valves small. Posterior border of posterior ear forming almost a right angle with the hinge margin.

Hinge and internal features not observed. Left valve ornamented with delicate, slightly imbricate, concentric lamellae and numerous (about 40 at shell height 25mm), radial ribs arranged in several orders. Intercalation of radial ribs as per specific diagnosis. Right valve with very numerous (about 40 at shell height 15mm), low radial ribs, not arranged in distinct orders, and very fine, concentric growth lines.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
CPC9285	27	12	27	16	3	8 (left valve)
CPC9286	30+	17	28+	20+	6	8 (" ")
CPC9324	11	5	12+	10	2	4 (" ")
CPC9287	35	15	32	17	5	4 (right valve)
CPC9325	13	5	12	8	2	2 (" ")

Remarks: Maccoyella muttaburraensis sp. nov. resembles the Aptian species M. barklyi (Moore, 1870) in outline. However, M. muttaburraensis is smaller, thinner shelled, has radial ornament on the posterior ear, 3-5 more primary radial ribs and the higher orders of ribs are introduced at earlier growth stages.

The ornament of M. muttaburraensis sp. nov. is comparable with that of Maccoyella sp. recently described from New Zealand by Speden (1968). Dr Speden has supplied casts of the new form which differs from the Queensland species in having slightly more anterior umbones and possibly in the lack of ornament on the right valve. As no known Australian Aptian species has ribbing like that of the New Zealand form, the relationship existing between *Maccoyella* sp. and *M. muttaburraensis* sp. nov. may suggest an Albian age for the New Zealand species.

Occurrence:

Mackunda Formation: GAB806; GAB812; GAB923; GAB1254; GAB1312; GAB1336; GAB1367; GAB1417; GAB2071; GAB2110.

Age: Early late Albian.

Maccoyella corbiensis (Moore), 1870

Pl.51, figs 11-12; pl.58, figs 1-8

Synonymy:

1870 *Avicula corbiensis* Moore, p.246, pl.11, fig.7.

1882 *Avicula corbiensis* Moore; Tate, p.149.

1889 *Avicula corbiensis* Moore; Tate, p.230.

1892 *Maccoyella corbiensis* (Moore); Etheridge Jnr, p.458 (*pars.*), pl.22, fig.8 only.

1901 *Maccoyella corbiensis* (Moore); Etheridge Jnr, p.17 (*pars.*).

1902a *Maccoyella corbiensis* (Moore); Etheridge Jnr, p.13 (*pars.*).

1902b *Maccoyella corbiensis* (Moore); Etheridge Jnr, p.21 (*pars.*) pl.1, figs 6-10.

1902 *Maccoyella corbiensis* (Moore); Etheridge Jnr & Dun, p.72 (*pars.*).

1927 *Maccoyella corbiensis* (Moore); Whitehouse, p.146.

1928 *Maccoyella corbiensis* (Moore); Whitehouse, p.276-277 (*pars.*).

1964 Maccoyella corbiensis (Moore); Day, table 3.

1965 Maccoyella corbiensis (Moore); Day, p.418-419.

1967 Maccoyella sp. aff. M. corbiensis (Moore); Skwarko, p.15, pl.4, fig.11.

Type: Holotype: Lost. Locality: "Mount Corby", probably from Doncaster Member, upper Aptian. Neotype: (now selected) F35513 UQ, a well preserved left valve.

Locality: RD92, Doncaster Member, upper Aptian.

Material: Twenty left valves and ten right valves.

Specific diagnosis: Small to medium sized, equilateral, gryphaeoid shaped Maccoyella with thickened, knob-like, posterior ears that lack emargination; hinge plate comparatively narrow; ornament multi-costate, non-spinose; left valves with 15-18 primary radial ribs, secondary ribs first intercalated about 10mm below the umbo, and rare tertiary radial ribs first intercalated about 25mm below the umbo; right valves with about 15 low, primary radial ribs and occasional secondary ribs first intercalated about 10mm below the umbo.

Description: Small to medium sized (length 10-40mm). Thick shelled. Equilateral. Inequivalve. Left valve erectly ovate, higher than long; well inflated. Right valve subquadrate, flat or slightly concave. Postero-dorsal and posterior margins almost straight, meeting at an angle of about 120°. Antero-dorsal margin of left valve gently concave. Other margins broadly convex. Umbones situated in the anterior two-fifths of shell. Umbo of left valve broad, not inrolled;

beak not separate from hinge margin. Umbo of right valve small, insignificant. Anterior ear of left valve small, weakly crenulate. Anterior ear of right valve large, thickened, separated from body of shell by a narrow, channel-like, byssal notch. Interior edge of right valve anterior ear with a central depression. Posterior ear of left valve thickened, knob-like, with an almost straight posterior border. Posterior ear of right valve large, flattened, not sharply defined, with a straight posterior border. Hinge plate thick; comparatively narrow in both valves. Hinge plate bevelled steeply inwards in the left valve; bevelled gently inwards in the right valve. Lower margin of hinge plate in left valve immediately in front of umbo with a small, knob-like "tooth", flanked by "sockets". Left valve "tooth" articulates with the socketed interior edge of the right valve anterior ear. Ligament pit in both valves trapeziform; well excavated; longitudinally striated. Anterior boundary of left valve ligament pit a very weak, slightly opisthocline ridge originating at the umbo; posterior boundary a low, very opisthocline ridge. Anterior boundary of right valve ligament pit opisthocline, formed by the raised, thickened edge of the anterior ear; posterior termination opisthocline to very opisthocline. Posterior adductor scars well impressed, with crescentic markings; scar in left valve ovate, larger than that in right valve; scar in right valve subcircular, closer to the posterior margin than that in left valve. Pallial line remote from margins, formed by a series of deep, elongate, almost continuous pits extending from the umbonal cavity to the posterior adductor scar. Ornament of left valve consisting of delicate, closely spaced, imbricate, concentric lamellae, numerous (25-35 at shell height 35mm), non-spinose radial ribs, arranged in primary, secondary and tertiary orders and prominent concentric depressions marking growth halts. Intercalation of radial ribs as per specific diagnosis. Radial ribbing interrupted and sometimes offset after major growth halts. Ornament of right valve consisting of delicate concentric growth lines, prominent concentric depressions marking growth halts, and low radial ribs (approx. 25 at shell height 35mm) arranged in primary and secondary orders. Intercalation of radial ribs as per specific diagnosis.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
F35513 UQ	32	14	37	17	4	15 (left valve)
F35518 UQ	32+	10+	35	17	4	15 (" ")
CPC9275	36	14	36	18	5	15 (" ")
CPC9327	16	6	19	10	3	5 (" ")
CPC9274	37	16	36	22	8	5 (right valve)

Remarks: Moore (1870, pl.11, fig.7) in describing Avicula corbiensis provided only an oblique anterior view of a left valve. The specimen illustrated was subsequently destroyed by fire in Sydney in 1882. Consequently, the species has been difficult to interpret. Etheridge

Jnr (1892, p.458) included a rather different form named Crenatula ? gibbosa by Etheridge Snr (1872, p.339, pl.19, fig.3) and later (1907, p.321) considered that Oxytoma rockwoodensis Etheridge Jnr (1892, p.448, pl.24, fig.15) might be conspecific with M. corbiensis (Moore). The current interpretation of Maccoyella corbiensis from Moore's description and illustration and the neotype now selected, specifically separates both of Etheridge's species. The specimen here designated neotype (F35513 UQ) is a left valve from RD92 in the Doncaster Member of the Roma area. Moore's type was from "Mount Corby". I have been unable to determine the position of this locality, but it is presumably in the Roma-Mitchell area. The neotype closely approaches the form illustrated by Moore.

Maccoyella corbiensis (Moore) resembles M. gibbosa (Etheridge Snr) but the shell of the former is equilateral, the umbo of the left valve is not inrolled, the beak is indistinct, the hinge plate is narrow and the primary and secondary radial ribs are strongly differentiated. Specimens from South Australia figured by Etheridge Jnr (1902a, pl.1, figs 9-10) and Ludbrook (1966, pl.14, figs 25, 27-28) as Maccoyella corbiensis are now included in M. gibbosa.

The form described from the sources of the Barcoo, Ward and Nive Rivers by Etheridge Jnr (1907, p.320, pl.61, figs 1-6) as Maccoyella corbiensis is now referred to M. rockwoodensis.

Bonarelli (1921, p.21, pl.2, figs 5a-b,6) compared a Patagonian species with M. corbiensis (Moore) and included these forms in a new subgenus Mimetostreon. Leanza (1963, p.222) (1967) subsequently renamed the Patagonian species Mimetostreon bonarellii. This form is congeneric with Maccoyella corbiensis, but is not conspecific. Maccoyella bonarellii is fully discussed in the section on M. rockwoodensis.

Specimens of Maccoyella cf. M. corbiensis (Moore) described by Skwarko (1966, p.74, pl.6, figs 1-11,text fig.4) from the Mullaman Beds are specifically distinct. They may be representatives of M. rostrata Etheridge Jnr (1901).

Whitehouse (1928) thought that the interpolation of the higher orders of radial ribs in Maccoyella corbiensis and in M. barklyi, was a mutant condition. He apparently included in M. corbiensis forms now referred to M. gibbosa. A close examination of left valves of both species has shown that tertiary ribs do not appear in either species until a height of about 25mm is attained. From this it is concluded that the interpolation of these ribs is a function of increasing size, not a mutant condition. Contrary to the claims of Whitehouse (1927) (1928), rib development lacks biostratigraphic significance.

Maccoyella corbiensis is a characteristic Aptian species. However, two occurrences are in Albian sediments near the base of the Coreena Member.

Occurrence:

Doncaster Member: ?"Mount Corby" (Moore, 1870), "Gammies Plains", "Bindango"; "Portion 167V, Parish Beaufort" (Whitehouse, 1927);

RD5; RD87; RD90; RD92; RD103; RD116; RD122; RD221; RD243; L98 GSQ; L99 GSQ; L105-6GSQ; L155 GSQ; L156 GSQ; GAB1137; GAB2098; GAB2101; GAB2167; SB105; SB123; SB125; BMR Richmond 1 (191'8" - 191'9").

Jones Valley Member: GAB699; GAB1139; GAB1140.

Coreena Member: GAB1933; SB101.

N.S.W.: Several localities reported by Etheridge Jnr (1902b).

W. Aust.: Gibson Desert (Skwarko, 1967).

Age: Late Aptian - ? early Albian.

Maccoyella gibbosa (Etheridge Snr), 1872

Pl.51, figs 9-10; pl.58, figs 9-14

Synonymy:

1872 Crenatula (?) gibbosa Etheridge Snr, p.339, pl.19, fig.3.

1892 Maccoyella corbiensis (Moore); Etheridge Jnr, p.458 (pars.), pl.22, fig.9 only.

1902a Maccoyella corbiensis (Moore); Etheridge Jnr, p.13 (pars.), pl.1, figs 9-10.

1902 Maccoyella corbiensis (Moore); Etheridge Jnr & Dun, p.72 (pars.).

1928 Maccoyella corbiensis (Moore); Whitehouse, p.276-277 (pars.).

?1961 Maccoyella aff. corbiensis (Moore); Cox, p.15, pl.1, figs 9-13.

1964 Maccoyella sp. aff. M. corbiensis (Moore); Day, table 3, p.18.

1966 Maccoyella corbiensis (Moore); Ludbrook, p.151 (pars.), pl.14, figs 25, 27-28.

Type: Holotype: F1237 QM. Locality: "Maryborough", Maryborough Formation, Aptian.

Material: Twenty well preserved left valves and a single right valve.

Specific diagnosis: Medium sized to moderately large, inequilateral, gryphaeoid shaped *Maccoyella*; expanded postero-ventrally, with inrolled umbones and distinct orthogryal beaks; hinge plate wide; ornament multicostate, non-spinose; left valves with about 15 primary radial ribs, secondary and tertiary radial ribs first intercalated about 10mm and 25mm below the umbo respectively, and quaternary ribs in large specimens; right valves with up to 30 fine low radial ribs, secondary and tertiary ribs intercalated 10mm and 20mm below the umbo respectively.

Description: Medium sized to moderately large (length 30-60mm). Thick shelled. Inequilateral. Inequivalve. Left valve gryphaeoid; expanded postero-ventrally; very inflated. Right valve erectly ovate to sub-rectangular, flat or slightly concave. Postero-dorsal margin short, straight. Antero-dorsal margin of left valve very concave. Anterior and ventral margins evenly convex. Posterior margin of right valve and posterior margin of left valve below the ear almost straight. Umbones situated in the anterior one-quarter to the anterior one-third of shell. Umbo of left valve broad, inrolled; beaks orthogryal, distinct from, and rising above the hinge margin. Umbo of right valve small, insignificant. Anterior ear of left valve small, crenulate. Anterior ear of right valve large, thickened, separated from the body of the shell by a narrow, channel-like, byssal notch. Interior edge of right valve anterior ear with a deep centrally placed depression. Posterior ear of left valve small, its posterior border forming almost a right angle with the hinge margin.

Posterior ear of right valve large, its posterior border forming an angle of about 120° with the hinge margin. Hinge plate thick, wide, bevelled steeply inwards in the left valve; set almost at right angles to the plane of commissure in the right. Lower margin of hinge plate of left valve immediately in front of the umbo with a large knob-like "tooth", flanked by deep "sockets". Left valve "tooth" articulates with the socketed interior edge of the right valve anterior ear. Ligament pit in both valves trapeziform; well excavated; longitudinally striated. Anterior boundary of left valve ligament pit a strong, slightly opisthocline ridge originating at the umbo; posterior boundary a low very opisthocline ridge. Anterior boundary of right valve ligament pit opisthocline, formed by the raised, thickened edge of the anterior ear; posterior termination a strong, very opisthocline ridge. Posterior adductor scar in left valve well impressed, bipartite, with crescentic markings. Scar situated about mid-height and slightly posterior of mid-length. Posterior adductor scar of right valve not observed. Pallial line remote from margins, formed by a discontinuous series of deep elongate pits extending from the umbonal cavity to the posterior adductor scar. Ornament of left valves consisting of delicate, closely spaced, imbricate concentric lamellae, numerous (40-45 at shell height 35mm), non-spinose, radial ribs arranged in primary, secondary, tertiary and quaternary orders, and prominent concentric depressions marking growth halts. Intercalation of radial ribs as per specific diagnosis. Radial ribbing interrupted and sometimes offset after major growth halts. Ornament of right valves consisting of delicate, concentric growth lines, fine, low radial ribs (approx. 50 at shell height 35mm), arranged in primary, secondary, and tertiary orders, and prominent, concentric depressions marking growth halts. Intercalation of radial ribs as per specific diagnosis. Posterior ears of both valves without radial ribbing.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
Left valves						
F1237 QM	57	20	60	25	7	26
F35520 UQ	32	9	34	14	3	14
F35512 UQ	31	9	30+	14	3	13
F35524 UQ	34+	10	42	15+	5	18
CPC9276	40	12	44	-	-	20
Right Valve						
F35517 UQ	32	10	36	15	3	6

Remarks: Etheridge Jnr (1892, p.458), and subsequent authors, have regarded Crenatula (?) gibbosa Etheridge Snr (1872, p.339, pl.19, fig.3) as a synonym of Avicula corbiensis Moore (1870, p.246, pl.11, fig.7). Etheridge Snr's taxon is now treated as a distinct species. The holotype (F1237 QM), an internal mould of a left valve from "Maryborough" (Aptian, Maryborough Formation), clearly shows the gryphaeoid shape, hinge features and musculature of the species. The exterior features are well displayed by a topotype (F1417 GSQ) figured by Etheridge Jnr (1892, pl.22, fig.9).

Maccoyella gibbosa (Etheridge Snr) resembles M. corbiensis (Moore). However, the former is inequilateral, has a gryphaeoid, postero-ventrally expanded left valve with an inrolled umbo, a distinct beak, and a wide hinge plate. Furthermore, M. gibbosa has more radial ribs (40-45 in left valve and 50 in right valve at height 35mm) than M. corbiensis (25-35 in left valve and 25 in right valve at height 35mm). Occurrences of Maccoyella gibbosa are confined to Aptian strata. The species occurs near the top of the Doncaster Member in the Surat and Northern Eromanga Basins.

South Australian specimens illustrated by Etheridge Jnr (1902a, pl.1, figs 9-10) and by Ludbrook (1966, pl.14, figs 25, 27-28) as Maccoyella corbiensis are here referred to M. gibbosa.

Specimens from the Nanutarra Formation described by Cox (1961, p.15, pl.1, figs 9-13) as Macccoyella aff corbiensis (Moore) have a wide hinge plate like that of M. gibbosa (Etheridge Snr). However, closer comparison is hampered by the limited number and incomplete preservation of specimens of the Nanutarra form available for study. It is particularly difficult to gauge the obliquity of the left valve.

Occurrence:

Doncaster Member: RD90; RD91; RD92; RD111; GAB884.

Maryborough Formation: "Maryborough" (Etheridge Snr, 1872).

Maree Formation: Several localities reported by Etheridge Jnr (1902a) and Ludbrook (1966).

Age: Late Aptian.

Maccoyella rockwoodensis (Etheridge Jnr), 1892

Pl.58, figs 15-18

Synonymy:

1892 Oxytoma rockwoodensis Etheridge Jnr, p.448, pl.24, fig.15.

1892 Undetermined bivalve Etheridge Jnr, pl.21, fig.15, right hand specimen.

1902 Oxytoma rockwoodensis Etheridge Jnr; Etheridge & Dun, p.75.

1907 Maccoyella corbiensis (Moore), Etheridge Jnr, p.320, pl.61, figs 1-6.

1950 Maccoyella rockwoodensis (Etheridge Jnr); David & Browne, p.498.

1965 Maccoyella rockwoodensis (Etheridge Jnr); Day, p.420.

1966 Maccoyella rockwoodensis (Etheridge Jnr); Ludbrook, p.153, pl.14, figs 22-24, 26.

Type: Holotype: F5628 GSQ. Locality: "Rockwood Station, Landsborough River", Mackunda Formation, lower upper Albian.

Material: About 50 separated right and left valves.

Specific diagnosis: Small to medium sized, inequilateral gryphaeoid shaped Maccoyella with emarginate posterior ears; hinge plate comparatively narrow; radial ribbing sparse; left valves with 12-15 non-spinose, primary radial ribs and very fine, secondary radial ribs first intercalated about 10mm below the umbo; right valves with up to 10 low, primary radial ribs and occasional secondary ribs first intercalated 10mm below the umbo.

Description: Small to medium sized (length 10-30mm). Thick shelled.

Inequilateral. Inequivalve. Left valve erectly ovate; higher than long; well inflated. Right valve suborbicular, smaller than left valve; flat or slightly concave. Postero-dorsal margins long, straight, about half shell length. Other margins broadly rounded. Umbones in anterior one-third of shell. Umbo of left valve broad, not inrolled. Umbo of right valve small, insignificant. Anterior ear of left valve small, crenulate. Anterior ear of right valve small, thickened, separated from body of shell by a narrow byssal notch. Interior edge of right valve anterior ear with a central depression. Posterior ear of left valve thickened; with an emarginate posterior border. Posterior ear of right valve large, flattened, not sharply defined, with an emarginate posterior border. Hinge plate thick; comparatively narrow in both valves. Hinge plate bevelled inwards in the left valve, bevelled outwards in the right valve. Lower margin of hinge plate in left valve immediately in front of the umbo with a small, knob-like "tooth" flanked by "sockets". Left valve "tooth" articulates with the socketed interior edge of the right valve anterior ear. Ligament pit in left valve elongated postero-ventrally; anterior boundary of ligament pit a low, slightly opisthocline ridge originating at the beak; posterior boundary of ligament pit a weak, very opisthocline ridge. Ligament pit of right valve deep, trapeziform, bounded anteriorly by the raised, thickened edge of the anterior ear; posterior termination of ligament pit opisthocline. Posterior adductor scar circular, large, well impressed, situated antero-dorsally in left valve and postero-ventrally in right valve. Pallial line remote from margins, formed by a series of deep, elongate, discontinuous pits extending from the umbonal cavity to the posterior adductor scar. Ornament of left valve consisting of delicate, closely spaced, slightly imbricate, concentric lamellae and sparse (22-25 at shell height 25mm) radial ribs arranged in primary and secondary orders. Intercalation of radial ribs as per specific diagnosis. Radial ribs interrupted by prominent growth halts. Posterior ear of left valve with a single fine radial rib. Ornament of right valve consisting of very delicate, concentric growth lines, and up to 10, low, primary radial ribs with occasional secondary radial ribs first intercalated about 10mm below the umbo. Ornament of right valves effaced in the umbonal region.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
Left valves						
F5628 GSQ	21	7	24	14	2	8
CPC9245	23	8	23+	15	3	10
Right valves						
CPC9288	21	6	21	15	3	3
CPC9323	17	6	15	12	2	2

Remarks: Etheridge Jnr (1907, p.321) thought that his species Oxytoma rockwoodensis Etheridge Jnr (1892) might be a synonym of Maccoyella corbiensis (Moore). However, that species, though similar in size and shape, is multicostate and the posterior border of the posterior ear is not sinuate. Specimens described from the "sources of the Barcoo, Ward and Nive Rivers" by Etheridge Jnr (1907, pl.61, figs 1-6) as Maccoyella corbiensis are here referred to M. rockwoodensis. The right hand specimen (F6134 GSQ) from "Aramac" figured by Etheridge Jnr (1892, pl.21, fig.5) as "Undetermined bivalve" represents the right valve of M. rockwoodensis.

Only two other described Australian species of Maccoyella, M. rostrata Etheridge Jnr (1901) and M. simplex (Moore, 1870), have sparse radial ribbing like that of M. rockwoodensis. Maccoyella rostrata figured by Etheridge Jnr (1892, pl.23, figs 8-9) (1901, pl.4, fig.3) is more equilateral than M. rockwoodensis, and has an upturned, expanded posterior ear. Maccoyella simplex figured by Etheridge Jnr (1892, pl.24, figs 2-5) as Oxytoma ? simplex is not well known, but appears to be very inequilateral, longer than high, and the posterior ear seems to attain a much larger size than that of M. rockwoodensis.

Casts of the types of the sparsely costate New Zealand species Maccoyella incurvata Waterhouse (1959, p.491, figs 1-18) kindly supplied by Dr I.G. Speden, clearly show that this species differs from M. rockwoodensis (Etheridge Jnr) in its greater inflation, inrolled umbones and spinose ribs. Additional information on the New Zealand species given by Speden (1968a) shows an almost complete overlap in the number of radial ribs (18-22 at shell height 31mm) with that of M. rockwoodensis.

Maccoyella bonarellii (= Mimetostreon bonarellii Leanza, 1963; 1967) described from the Lake San Martin district of Argentina by Bonarelli (1921, p.21, pl.2, figs 5a-b, 6) as *Gryphaea (Mimetostreon)* cf. *corbiensis* (Moore) and by Piatnizky (1938, p.74, pl.5, figs 24-25) as *Gryphaea* cf. *corbiensis* (Moore) is also related. Dr A.C. Riccardi of the Instituto Nacional de Geologia y Mineria, Buenos Aires, has kindly supplied photographs of the Argentinian form. These indicate that *M. bonarellii* differs from *M. rockwoodensis* in its greater inflation, more inrolled umbones and wider hinge plate. The Argentinian species is perhaps more closely allied to the New Zealand *M. incurvata*. *Maccoyella bonarellii* is associated with late Aptian species of the ammonite genera *Tropaeum*, *Sanmartinoceras*, and *Aioloceras*. Its relationship with *M.incurvata* may date the New Zealand species as late Aptian.

Maccoyella rockwoodensis is an Albian species. It has a few representatives in the Coreena Member, but is commonest in the Allaru Mudstone and Mackunda Formation.

Occurrence:

Coreena Member: ? "Sources of the Barcoo, Ward and Nive Rivers, south central Queensland" (Etheridge Jnr, 1907); GAB1936?; BMR Longreach 5 (131'7" - 132').

Allaru Mudstone: "Aramac" (Etheridge Jnr, 1892); GAB1041; GAB1228; GAB1934; GAB2034?; GAB2070; GAB2104?

Mackunda Formation: "Rockwood Station, Landsborough River" (Etheridge Jnr, 1892); GAB653; GAB674; GAB678; GAB812; GAB813; GAB814; GAB815; GAB822; GAB930; GAB1212; GAB1607; GAB2100; GAB2103.

Maree Formation: Several localities reported by Ludbrook (1966).

Age: Early - early late Albian.

Genus Meleagrinella Whitfield, 1885

(=Echinotis Marwick, 1935)

Type species (by subsequent designation, Etheridge Jnr, 1892, p.453): Avicula curta Hall, 1852, Jurassic, U.S.A.

Generic diagnosis: Usually small. Orbicular to subquadrate. Very inequivalve. Left valve strongly convex, with a prominent umbo. Right valve feebly convex, often smaller than the left. Anterior ear of right valve projecting, separated anteriorly from the body of the shell by a narrow byssal notch. Anterior ear of left valve small or absent, sometimes crenulate. Posterior ears short. Hinge plate narrow in both valves; slightly inclined inwards in the left valve; inclined outwards almost perpendicular to the plane of commissure in the right. Ligament pit asymmetrically triangular, elongated posteriorly, its anterior termination situated immediately below the umbo in each valve. Hinge plate in front of the umbo in the left valve raised; frequently with a small, tooth-like thickening and anterior recess ("gelenkgrube") developed on the lower margin. Posterior adductor scar small, situated just posterior to the centre of the valve. Anterior adductor scar rarely observed, very small, situated just below the anterior ear.

Exterior of left valves usually ornamented with narrow radial costae frequently arranged in several orders, and crossed by well defined concentric growth lamellae. Right valves smooth or with faint radial costae and fine concentric growth lines.

Range: Rhaetic - Upper Cretaceous.

Remarks: Whitfield (1885, p.71) in proposing this genus nominated *Avicula curta* Hall and *Pseudomonotis* (*Eumicrotis*) *orbiculata* Whitfield as types. Etheridge Jnr (1892, p.453) and Cox (1941, p.134) selected *Avicula curta* Hall as type species. According to Cox, the differences between *Avicula curta* and *Avicula echinata* Wm Smith (the type species of *Echinotis* Marwick, 1935) are slight, and consequently he regarded *Echinotis* as a synonym of *Meleagrinella*. This view has gained general acceptance, although it has been questioned by Brunnschweiler (1960).

Meleagrinella is closely related to *Maccoyella* and small specimens of the latter genus are difficult to distinguish from those of *Meleagrinella* on external features alone. In *Meleagrinella* the hinge plate of the left valve is narrower, the tooth-like thickening, if developed, is slightly more anteriorly situated and is always much smaller and not as sharply defined as the left valve "tooth" of *Maccoyella*. Furthermore, the right valve hinge plate of *Meleagrinella* is inclined outwards not inwards, as in *Maccoyella*. Good illustrations of the hinge of *Meleagrinella* are given by Pompeckj (1901, pl.15, figs 4,7,15,19) and Borissjak (1909, pl.2, figs 14b,d,e,15a,d,e,17b,d, and 20a,c,e,f).

Species of Pseudavicula Etheridge Jnr (1892) have been confused with those of Meleagrinella as they frequently are similar in size and have somewhat similar ornament. However, unlike Meleagrinella which is markedly inequivalve, Pseudavicula has weakly inflated valves of almost equal convexity. Also, in Pseudavicula the hinge plate of the left valve narrows anteriorly, and there is no trace of the tooth-like thickening commonly developed in Meleagrinella.

Meleagrinella woodsi Day, 1967

Pl.59, fig.1; text fig.16E,F

Synonymy:

1927 Coilotis lens gen. and sp. nov. Whitehouse, p.145, 146 (nom. nud.).

1960 Pseudavicula papyracea Etheridge Jnr; Day, p.311.

1964 Pseudavicula sp. (=Coilotis lens Whitehouse, 1927); Day, p.14, table 3.

1967b Meleagrinella woodsi Day, p.20, pl.5, figs 5-15.

Types: Holotype: F35510 UQ. Locality: RD99. Paratypes: F7910 GSQ; F7913 GSQ; F35623 UQ; F28848 UQ; F35666 UQ. Locality: F7910, F7913, L153 GSQ; F35623 UQ, L2162 UQ; F28848 UQ, L318 UQ; F35666 UQ, RD99. All specimens from

Minmi Member, lower Aptian.

Material: About 80 left and right valves, many of which retain shell material.

Specific diagnosis: Acline, erectly ovate *Meleagrinella*, with a fairly short hinge line; left valves ornamented with rather sparse, often faint radial ribs, and subordinate, imbricate, concentric lamellae; right valves with mainly concentric ornament.

Description: Small to medium sized (length 10-30mm). Erectly ovate; higher than long; acline. Markedly inequivalve. Left valve very convex at mid-length. Both valves with a variably developed postero-ventral sulcus. Right valve weakly inflated. Hinge line shorter than shell length. Umbo of left valve prominent, subcentral. Umbo of right valve small. Posterior ears of both valves not sharply defined, without emargination. Anterior ear of left valve crenulate, each ridge marking a growth stage. Anterior ear of right valve very prominent, projecting upwards and inwards. Byssal notch very deep. Hinge plate of left valve narrow. Ligament pit of left valve occupying the posterior portion; deepest anteriorly, where it is bounded by a strong, opisthocline ridge originating at the umbo. Below and just in front of the left valve umbo there is a tooth-like thickening; immediately anterior to this there is a small recess ("gelenkgrube"). Postero-dorsal margin of right valve with a narrow hinge plate, inclined outwards almost perpendicular to the plane of commissure. Ligament pit of right valve shallow, asymmetrically triangular; bounded anteriorly by the thickened anterior ear. Musculature not observed. Left valves ornamented with broad radial costae (approx. 35 at shell height 15mm), not differentiated into primaries and secondaries, often faint; concentric ornament consisting of delicate, subordinate, imbricate lamellae. Right valves ornamented with very faint radial lines and more conspicuous concentric lamellae.

Dimensions: (mm)	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
Left valves						
F33510 UQ	26	12	26+	14	5	7
F35623 UQ	22	11	26	12	3	6
F7910 GSQ	18	8	21	10	2	6
F7913	14	7	16	8	2	4
Right valves						
F28848 UQ	c.16	8	18	10	2	2
F35666 UQ	17	8	18	7	2	2

Remarks: This species, described by Day (1967b, p.20, pl.5, figs 5-15), is highly characteristic of the Minmi Member. *Meleagrinella merivalensis* sp. nov., which characterizes the underlying Nullawurt Member, differs principally in its more orbicular shape.

Pseudomonotis superstes Spitz (1914, p.18, figs 6,7) from the Lower Cretaceous Guiemal Sandstone of Pakistan is very similar in shape, and apparently also in ornament, though this is less certain as Spitz's figures are composites drawn from several specimens.

Meleagrinella cf. M. superstes figured by Brunnschweiler (1960, pl.1, figs 20,22,25,26, text fig.15) from the Neocomian of Dampier Peninsula is more orbicular. It is closer to the Pseudomonotis sp. of Whitehouse (1946, pl.1, figs 7,8) and Meleagrinella merivalensis sp. nov. described below.

Meleagrinella woodsi is very closely allied to a species described from the Mullaman Beds by Skwarko (1966, p.80, pl.5, figs 1-5) as Pseudavicula dickinsi. The two species are comparable in size, shape and hinge features, but M. dickinsi possesses more radial costae. Skwarko stated that his species was equivalve, but specimens illustrated by him are all left valves. The position of the posterior adductor muscle scar on the internal mould (CPC4747) figured by Skwarko (pl.5, fig.4) as a right valve, clearly indicates that the specimen is actually a left valve. The paratype specimen (CPC4938) figured by Skwarko (pl.15, fig.5) as a right valve, displays a narrow hinge plate and a tooth-like thickening below the umbo. These are features characteristic of left valves of Meleagrinella. The holotype specimen (CPC4746) (pl.5, fig.1) is also a left, not a right valve. Skwarko assigned his species a late Neocomian age, but as discussed in the section on Australian Correlations, M. dickinsi is possibly the northern temporal equivalent of M. woodsi and both species are probably of early Aptian age.

Undescribed forms reported by Woods (1963a,b) from the Neocomian-Aptian Battle Camp Formation of the Laura Basin, are also similar, but are probably not conspecific.

Pseudavicula anomala (Moore), which has somewhat similar ornament, may be distinguished by its more anterior umbones and its weakly inflated valves which are almost of equal convexity. In addition, the hinge of the left valve is quite different.

Occurrence:

Minmi Member: "Red Hill"; "Clerk Creek Crossing"; "State Farm Well"; "Murray's well (80ft)" (Whitehouse, 1927); RD6; RD78; RD82; RD94; RD97; RD99; RD109; RD283; L318 UQ; L2162 UQ; L143 GSQ; L147 GSQ; L148 GSQ; L151 GSQ; L152 GSQ; L153 GSQ; SB122; SB124; SB127; SB128; SB226; SB227; SB228; SB231.

Age: Early Aptian.

Meleagrinella merivalensis sp. nov.

Pl.59, figs 2-7

Synonymy:

cf. 1946 Pseudomonotis sp. Whitehouse, p.18, pl.1, figs 7-8.

1964 "Pseudomonotis" sp. (=Pseudomonotis sp. Whitehouse, 1946); Day, p.14, table 3.

1967b Meleagrinella sp. Day, p.21, pl.5, figs 16-17.

Types: Holotype: CPC9326, internal and external mould of a left valve. Paratypes: CPC9488, internal mould of a left valve; CPC9489, external mould of a left valve; CPC9490 and CPC9491, external moulds of right valves. Locality: Holotype, SB239; Paratypes CPC9488, CPC9490 and CPC9491, SB230; CPC9489, SB221. All specimens from the Nullawurt Member, Neocomian.

Material: Thirty internal and external moulds of separated valves.

Specific diagnosis: Orbicular Meleagrinella; left valves ornamented with very numerous, primary radial ribs and finer, intercalated secondary radial ribs, together with subordinate, closely spaced, imbricate concentric lamellae; right valves apparently with fine concentric growth lines only.

Description: Small (length 10-20mm). Orbicular; height and length approximately equal; slightly expanded postero-ventrally. Inequivalve. Left valve moderately inflated. Right valve weakly inflated. Hinge line short. Umbo of left valve prominent, subcentral. Umbo of right valve small.

Posterior ears of both valves comparatively large, well defined, without emargination. Posterior margin of posterior ears meeting postero-dorsal margin almost at 90°. Anterior ear of left valve small, crenulate. Anterior ear of right valve small, thickened, projecting upwards; separated from the body of the shell by a narrow byssal notch. Hinge plate of left valve narrow, inwardly inclined. Ligament pit of left valve occupying most of posterior part of hinge plate; anterior boundary of ligament pit a low, slightly opisthocline ridge originating at the umbo; posterior boundary of ligament pit indistinct. Ventral margin of hinge plate of left valve below and slightly in front of the umbo with a small, knob-like "tooth" and recess (gelenkgrube). Postero-dorsal margin of right valve with a narrow hinge plate, inclined outwards almost perpendicular to the plane of commissure. Ligament pit of right valve asymmetrically triangular, bounded anteriorly by the thickened anterior ear. Musculature and pallial features not observed. Left valves ornamented with very numerous (approx. 50 at shell height 15mm), broad, primary radial costae, and finer intercalated secondary ribs, together with subordinate, closely spaced, imbricate concentric lamellae. Right valves apparently with fine concentric growth lines only.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
Left valves						
CPC9326	16	8	16	10	3	4
CPC9488	16	8	17	9	3	5
CPC9489	6	3	6	c.3	c.1	2
Right valves						
CPC9490	10	4	10	5	c.2	2
CPC9491	8	3	8	4	c.1	2

Remarks: Specimens from the upper part of the Nullawurt Member in the Merivale Syncline are possibly conspecific with those of Pseudomonotis sp. described by Whitehouse (1946, p.18, pl.1, figs 7-8) from Neocomian sediments, near Stanwell. However, the Stanwell specimens have somewhat coarser primary radial costae. The single, abraded left valve from the Minmi Member near Blythdale, illustrated by Day (1967b, p.21, pl.5, figs 16-17) as Meleagrinella sp., is now referred to this species.

Meleagrinella merivalensis sp. nov., is readily distinguished from M. woodsi Day, the characteristic Meleagrinella of the overlying Minmi Member, by its orbicular shape and radial ribbing arranged into primary and secondary orders.

Meleagrinella _dickinsi_ (Skwarko) from the Mullaman Beds has similar ornament but differs in its erectly oval shape.

Some of the specimens from "crossing of Normanby River, 1.3 miles north-east of Lakefield Homestead" (Battle Camp Formation) reported by Woods (1963a) as "_Pseudomonotis_" spp. are very similar to _Meleagrinella_ _merivalensis_ sp. nov. and may be conspecific. At the Normanby River locality "_Pseudomonotis_" spp. is associated with the Neocomian ammonite _Hatchericeras_ _lakefieldense_ Woods (1962a).

Poorly preserved specimens described from the Neocomian of Dampier Peninsula by Brunnschweiler (1960, p.20, pl.1, figs 20,22,25,26, text fig.6) as _Meleagrinella_ cf. _M._ _superstes_ (Spitz) are also similar.

The ornament of _Meleagrinella_ _merivalensis_ sp. nov. resembles that of the Jurassic species _M._ _echinata_ (Smith) as figured by Morris and Lycett (1853, pl.2, figs 7,7a & b), but the latter has an emarginate posterior ear.

Occurrence:

Nullawurt Member: SB221; SB230; SB233; SB239.

Minmi Member: L134 GSQ.

Age: Neocomian.

Genus <u>Pseudavicula</u> Etheridge Jnr, 1892

<u>Type species</u> (by original designation): <u>Lucina anomala</u> Moore, (1870), Aptian, Australia.

<u>Generic diagnosis</u>: Small to medium sized. Thin shelled. Orbicular to erectly ovate. Equilateral or inequilateral. Slightly inequivalve; left valve more convex and sometimes larger than the right valve. Weakly inflated. Umbones small, subcentral or anterior. Anterior ear rudimentary in the left valve; small and upturned in the right valve. Anterior ear of right valve separated from the body of the shell by a narrow notch in valve margin. Posterior ears of both valves large, not sharply defined from the body of the shell. Hinge plate of the left valve narrow, lying in the plane of commissure. Hinge plate of the right valve bevelled towards exterior of that valve. Hinge plate reduced in width immediately below the umbo. Ligament pit long, narrow, shallow; occupying most of the hinge plate behind the umbones. Anterior boundary of ligament pit formed by the opisthocline edge of a slightly raised flat triangular area which adjoins the anterior ear. Posterior boundary of ligament pit indistinct. Posterior adductor scar large, ovate, usually well impressed. Exterior ornamented with a reticulate network of fine radial and concentric costae, or with fine concentric growth lines only.

<u>Range</u>: Aptian-Albian.

<u>Remarks</u>: <u>Pseudavicula</u> is a rather distinctive genus

characterized by a peculiar hinge plate, and thin, weakly inflated, slightly inequivalve shells with rudimentary anterior ears in the left valve. The hinge features were not known at the time the genus was proposed by Etheridge Jnr (1892, p.449). They were first illustrated by Whitehouse (1925, pl.1, figs 2-3) who reported (p.28) that there was no byssal sinus in the right valve. Subsequently, Dickins (1960) demonstrated the presence of a small anterior ear and a byssal notch in the right valve.

Dickins (1960, p.395) thought that *Pseudavicula* was closely related to aviculopectinids of the subfamily Streblochrondriinae. Vokes (1967, p.184) included *Pseudavicula* and *Streblochrondria* in the family Streblopteriidae. However, the ears of *Pseudavicula* are quite unlike those of members of this family which are all of Palaeozoic age. Cox (1962, p.593) appears to have regarded *Pseudavicula* as a member of the Oxytomidae and the genus was referred to that family by Day (1967b, p.23). The comparison of the hinge features of *Pseudavicula* with those of some oxytomid genera (Fig.16) shows that the hinge of *Pseudavicula* is more like that of *Oxytoma* than those of *Maccoyella* and *Meleagrinella*.

Pseudavicula is represented in Australia by one Aptian species, *P. anomala* (Moore), and an Albian species, *P. papyracea* Etheridge Jnr. *Avicula alata* Etheridge Snr (1872, p.342, pl.20, fig.8 *non* Kloeden, 1834), which Etheridge Jnr (1892, p.563) doubtfully included in _Pseudavicula_, and which Ludbrook (1966, p.154) renamed _Pseudavicula etheridgei_, appears to be a species of _Meleagrinella_ or _Maccoyella_.

The only definite extra-Australian occurrences of _Pseudavicula_ are those reported by Glaessner (1945) from the Albian of New Guinea. _Pseudavicula ? africana_ Etheridge Jnr (1907a, p.71, pl.2, figs 8-11) from the Cenomanian of Zululand (Rennie, 1936, p.301), _Pseudomonotis ? inopis_ Stoliczka (1870, p.403, pl.38, figs 7-8) from the Senonian of Southern India, and "_Pseudomonotis_" _laevis_ (Blake and Hudleston) refigured by Arkell (1933, p.200, pl.24, figs 11-12) from the Corallian of England, are possibly members of a different genus related to _Pseudavicula_.

Pseudavicula anomala (Moore), 1870

Pl.59, figs 8-16; text fig. 16C,D

Synonymy:

1870 _Lucina anomala_ Moore, p.251, pl.14, fig.4.

1870 _Lucina ? australis_ Moore, p.251, pl.14, fig.5.

1884 _Avicula orbicularis_ Hudleston, p.341, pl.11, fig.10.

1890 _Pseudavicula anomala_ (Moore); Hudleston, p.244.

1892 _Pseudavicula anomala_ (Moore); Etheridge Jnr, p.450, pl.24, figs 6,8,11.

1892 <u>Pseudavicula</u> <u>australis</u> (Moore); Etheridge Jnr, p.451, pl.24, figs 7,9,10,12,13.

1902a <u>Pseudavicula</u> <u>australis</u> (Moore); Etheridge Jnr, p.15, pl.2, fig.2.

1902a <u>Pseudavicula</u> <u>anomala</u> (Moore); Etheridge Jnr, p.16, pl.2, fig.1.

1902b <u>Pseudavicula</u> <u>anomala</u> (Moore); Etheridge Jnr, p.15, pl.7, fig.11; pl.10, fig.4.

1925 <u>Pseudavicula</u> <u>anomala</u> (Moore); Whitehouse, p.27, pl.1, figs 1-2.

1927 <u>Lucina</u> <u>anomala</u> Moore; Finlay, p.529.

1961 <u>Pseudavicula</u> <u>australis</u> (Moore); Woods, p.6.

1964 <u>Pseudavicula</u> <u>anomala</u> (Moore); Day, table 3, p.17-18.

1965 <u>Pseudavicula</u> <u>anomala</u> (Moore); Day, p.418.

1966 <u>Pseudavicula</u> <u>anomala</u> (Moore); Ludbrook, p.153, pl.16, figs 1-4.

1967 "<u>Pseudavicula</u> <u>anomala</u>" (Moore); Skwarko, p.16, pl.2, figs 11-18.

1967b <u>Pseudavicula</u> <u>anomala</u> (Moore); Day, p.23, pl.5, fig.4.

<u>Types</u>: <u>Lucina</u> <u>anomala</u> Moore. <u>Holotype</u>: Lost. <u>Locality</u>: "Wollumbilla", Doncaster Member, upper Aptian. <u>Neotype</u>: (herein designated) F7840 GSQ, a partially exploited specimen with slightly opened valves. <u>Locality</u>: L98 GSQ, Doncaster Member, upper Aptian.

<u>Lucina</u> ? <u>australis</u> Moore. <u>Holotype</u>: Lost.

Locality: "Wollumbilla", Doncaster Member, upper Aptian.

Avicula orbicularis Hudleston. Lectotype & 5 paralectotypes: L9697 BMNH. Locality: "Mt Hamilton, 20 miles S.W. of L. Eyre, or 40 miles S.W. of Peake", Maree Formation, Aptian.

Material: About 500 specimens with valves closed or separated, usually occurring in crowded masses.

Specific diagnosis: Small to medium sized, inequilateral, suborbicular Pseudavicula; musculature well impressed; posterior ears obtusely rounded, lacking emargination; exterior ornament reticulate.

Description: Small to medium sized (length 5-60mm). Thin shelled. Suborbicular. Inequilateral. Weakly inflated. Slightly inequivalve; the left valve more convex than the right. Umbones small, situated within the anterior one-third and the anterior two-fifths of the shell. Postero-dorsal margin straight, sloping. Other margins gently convex. Anterior ear rudimentary in left valve. Anterior ear of right valve small, upturned, separated from the body of the shell by a narrow notch in shell margin. Byssal notch a channel on inside surface of valve. Posterior ears large; not sharply defined from the body of the shell. Posterior margin of posterior ear without emargination, meeting the postero-dorsal margin at an obtuse angle. Hinge and ligament features as for genus. Hinge plate with longitudinal growth lines. Posterior adductor muscle scar large, subcentral and slightly posterior; subreniform with crescentric lines marking successive growth stages. Pallial line a series of deep, very elongate, more-or-less continuous pits extending from the posterior adductor towards the anterior side of the umbonal cavity; pallial line near umbonal cavity a row of small, deep pits. Exterior ornament a delicate, reticulate network of numerous (approx. 60 at shell height 10mm; approx. 120 at shell height 40mm), fine, straight, closely spaced radial costae, and subordinate, fine, closely spaced, concentric lamellae. Radial costae increase by intercalation; not strongly differentiated into orders. Larger specimens with widely and irregularly spaced concentric depressions marking growth halts.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
F7840 GSQ	42	15	42	18	3	-
F7839 GSQ	34	12	34	17	3	11
F35535 UQ	54	21	55	25	5	8 (left valve)
F35537 UQ	48	20	50	22	5	7 (" ")
F35545 UQ	50	20	55	23	5	6 (right valve)
F28839 UQ	14	5	15	8	1.5	3 (left valve)
F28840 UQ	14	6	15	8	1.5	2 (" ")

Remarks: Moore's types from "Wollumbilla" were lost in the Garden Palace fire in Sydney in 1882 (Etheridge Jnr, 1892, p.xvi). The neotype (F7840 GSQ) now selected from topotypic material closely resembles the forms figured by Moore (1870, pl.14, figs 4-5). The hinge of both valves of Pseudavicula anomala are now illustrated from topotypes. According to Finlay (1927) Lucina anomala Moore, 1870, is not preoccupied by Lucina anomala Hoernes, 1848, as the latter is a nomen nudum. I have not seen the work of Hoernes and am thus unable to verify Finlay's statement.

The ornament exhibited by Pseudavicula anomala is dependent on the degree of exfoliation. Exterior surfaces have a reticulate ornament. With slight exfoliation, the subordinate concentric lamellae are lost. The innermost shell surface is smooth.

Pseudavicula papyracea Etheridge Jnr from Albian sediments of the Great Artesian Basin and New Guinea, lacks well developed radial costae, has emarginate posterior ears, faintly impressed musculature, is thinner shelled, more inequivalved, and is generally smaller.

Occurrence:

Minmi Member: RD78; RD98; RD107; RD109; RD301?; L144 GSQ; L146 GSQ; L269 GSQ; L272 GSQ; L2162 UQ.

Doncaster Member: "Wollumbilla" (Moore, 1870); "Maranoa River" and "Maranoa river, half a mile above Mitchell Railway Station"

(Etheridge Jnr, 1892); RD117; RD122; RD198; L92 GSQ; L97 GSQ; L98 GSQ; L100 GSQ; L102 GSQ; L103 GSQ; GAB870; GAB884; GAB1017; GAB1036; GAB1136; GAB1137; GAB1145; GAB2092; GAB2098; GAB2101; GAB2118; GAB2152; GAB2155; GAB2156; GAB2162; GAB2163?; GAB2166; GAB2167; GAB2169; SB117; SB129?; BMR Richmond 1 (174'5"-174'7"); BMR Richmond 2 (165'2"-165'4-1/2").

Jones Valley Member: GAB1139; GAB1140.

Coreena Member: GAB1933? (remanie).

Maryborough Formation: Several localities in UQ collections.

Blackdown Formation: W3; W34 (Woods, 1961).

Maree Formation: "Mt Hamilton, 20 miles S.W. of L. Eyre or 40 miles S.W. of Peake" (Hudleston, 1884); "Coottanoona and L. Eyre district" (Etheridge Jnr, 1892); "Lake Eyre basin", "Primrose Springs near the Peake"; "bore at Hergott Springs, 150 ft from the surface" (Etheridge Jnr, 1902a); "Peake" (Whitehouse, 1925); and numerous localities reported by Ludbrook (1966).

N.S.W.: "Mt Poole district" and "well on Mt Stuart run" (Etheridge Jnr, 1902b).

W. Aust.: Gibson Desert (Skwarko, 1967).

Age: Early-late Aptian.

Pseudavicula papyracea Etheridge Jnr, 1907

Pl.59, figs 17-22

Synonymy:

1892 Undetermined bivalve, Etheridge Jnr, p.482, pl.21, figs 14 & 15 (left hand specimen only).

1892 Undetermined bivalve resembling genus Meleagrinella Whitfield; Etheridge Jnr, p.482, pl.21, fig.16.

1907 Pseudavicula papyracea Etheridge Jnr, p.319.

1945 Pseudavicula papyracea Etheridge Jnr; Glaessner, p.159, pl.6, fig.11.

1958 Pseudavicula papyracea Etheridge Jnr; Glaessner, p.201.

1960 Pseudavicula papyracea Etheridge Jnr; Dickins, p.394 only.

1965 Pseudavicula papyracea Etheridge Jnr; Day, p.420.

Type: Holotype: F1289 GSQ. Locality: "Coreena woolshed", Coreena Member, lower or middle Albian.

Material: About 250 specimens mostly with valves separated.

Specific diagnosis: Small; right valve subquadrate; left valve erectly ovate, larger and more convex than right valve; posterior margin of posterior ears emarginate, forming almost a right angle with the postero-dorsal margin; musculature very faintly impressed; ornament subdued; consisting of regularly spaced, weakly elevated concentric ribs, fine concentric growth lines and very fine radial striae.

Description: Small (length rarely exceeds 15mm). Very thin shelled. Inequilateral. Slightly inequivalve; left valve larger and more convex than the right. Left valve erectly ovate; height greater than length. Right valve subquadrate; length equal to height. Weakly inflated; maximum inflation in the umbonal region. Dorsal margins straight; about two-thirds of shell length. Other margins gently convex. Posterior ears of both valves large, not sharply defined from the body of the shell. Posterior margin of posterior ears meeting postero-dorsal margin almost at right angles; sinuate or emarginate immediately below this junction. Anterior ear of left valve rudimentary. Anterior ear of right valve small, commonly not preserved, separated from the body of the shell by a narrow notch in valve margin. Umbones small; situated in the anterior one-third of shell; higher in the left valve than the right. Hinge features not observed. Posterior adductor scar very faintly impressed, suboval; subcentral and slightly posterior. Exterior ornament per specific diagnosis.

Dimensions: (mm)

	Length	Anterior length	Height	Length of dorsal margin	Anterior length of dorsal margin	Inflation
Left valves						
CPC9320	11+	-	18	-	-	3
CPC9321	15	6	17	8+	-	3
CPC9370	15	5	18	10	2	3
CPC9318	16	6	17	12	2	3
Right valves						
F1289 GSQ	11+	5+	13	9+	2	2
CPC9319	14	4	14	11	2	2
CPC9317	14	5	14	11	3	2

Remarks: As Dickins (1960, p.394) observed, the holotype of *Pseudavicula papyracea* is the specimen figured by Etheridge Jnr (1892, pl.21, fig.14). This specimen (F1289 GSQ) is exfoliated and incomplete but topotypic material now illustrated reveals the shape and ornament of both valves. Specimens from "Aramac" figured by Etheridge Jnr (1892, pl.21, fig.15, left hand specimen F1299 GSQ; fig.16, F1295 GSQ) are conspecific. The right hand specimen of fig.15 is a right valve of *Maccoyella rockwoodensis*.

Pseudavicula papyracea is very common in silty sandstones of the Coreena Member and the Mackunda Formation, but occurs sparsely in the Allaru Mudstone. Specimens (F2315-F2317 GSQ) figured by Dickins (1960, pl.63, figs 1-5) from Aptian sediments near Yuelba, and compared with *Pseudavicula papyracea*, resemble that species in outline, but the left valves have well developed radial ribs. They probably represent an unnamed species of *Pseudavicula*.

The Aptian species *Pseudavicula anomala* (Moore) is thicker shelled and less inequivalved than *P. papyracea*, while the ornament and the shape of the posterior ears of the two species are markedly different.

Occurrence:

Coreena Member: "Coreena woolshed" & "Aramac" (Etheridge Jnr, 1892); "sources of Barcoo, Ward and Nive Rivers" (Etheridge Jnr, 1907); GAB1408; GAB1433; GAB1438; GAB1936; GAB2059; GAB2107; GAB2108.

Toolebuc Limestone: GAB772?

Allaru Mudstone: GAB1041; GAB1228; GAB1611.

Mackunda Formation: GAB652; GAB653; GAB674; GAB851; GAB907; GAB910; GAB914; GAB1107; GAB1212; GAB1216; GAB1217; GAB1219; GAB1220; GAB1250; GAB1322; GAB1331; GAB1335; GAB1336.

New Guinea: "Purari Formation" (Glaessner, 1945).

Age: Early - early late Albian.

Subclass ANOMALODESMATA Dall, 1889

Order PHOLADOMYOIIDA Newell, 1965

Suborder PHOLADOMYINA Newell, 1965

Superfamily PANDORACEA Rafinesque, 1815

Family Laternulidae Hedley, 1918

Remarks: This family includes thin, translucent shells, which are ovately oblong in shape, gape anteriorly and posteriorly, have fissured umbones, a wide shallow pallial sinus, lack teeth and have a prominent chondrophore which projects below the hinge margin. The Laternulidae first appeared in the Jurassic and the group survives in Recent seas.

Genus *Periplomya* Conrad, 1870

(=*Leptomya* Conrad, 1867; Plicomya Stoliczka, 1870)

Type species (by monotypy): *Periploma applicata* Conrad, 1858, Upper Cretaceous, U.S.A.

Generic diagnosis: Thin shelled. Oblong-ovate; almost equilateral. Slightly inequivalve. Anterior truncate or obtusely rounded, gaping. Beaks opisthogyral. An obscure fissure and rib extends from the anterior side of the umbo towards the antero-ventral extremity. Hinge with chondrophore tapered and acutely rounded ventrally. Chondrophore attached anteriorly to a rib or support. Exterior with fine concentric wrinkling and fine concentric growth lines.

Range: Neocomian - Eocene.

Remarks: *Periplomya* Conrad (1870, p.76) a new name for the pre-occupied *Leptomya* Conrad (1867, p.15) has two months priority over the replacement name *Plicomya* Stoliczka (1870, p.69). Stoliczka (1870, p.xvi) cited "*Leptomya peculiaris*" as type species, but the sole species included without doubt in "*Leptomya*" Conrad (1867, p.15) was *Periploma applicata* Conrad (1858, p.324). This species is therefore the type by monotypy.

Conrad (1867, p.15) referred his genus to the Anatinidae (=Laternulidae). Stewart (1930, p.297) transferred it to the Thraciidae, a group which resembles *Periplomya* in outline. However, as Ichikawa and Maeda (1958b, p.103) have noted, *Periplomya* is closely allied to *Laternula*. The former is less expanded anteriorly and the umbonal fissure is virtually obsolete. Vokes (1967, p.336) listed *Periplomya* in the

Laternulidae.

Conrad (1870, pl.3, fig.10) figured the hinge of the type species, but the hinges of most of the other species referred to _Periplomya_ have not been illustrated.

Periplomya cf. _robinaldina_ (d'Orbigny), 1845

Pl.43, fig.9

Synonymy:

cf.1909 _Thracia robinaldina_ ? (d'Orbigny); Woods, p.242, pl.40, figs 1-3.

1927 _Thracia_ ? sp. Whitehouse, p.146.

1964 _Thracia_ sp. aff. _T. robinaldina_ (d'Orbigny); Day, table 3.

1967b _Periplomya_ cf. _robinaldina_ (d'Orbigny); Day, p.24, pl.2, figs 7-9.

Material: Seven separated right and left valves retaining shell, and three internal and external moulds.

Specific diagnosis: Elongately ovate _Periplomya_ with a straight postero-dorsal margin, gently truncate posterior and a weakly impressed anterior carina.

Description: Small to medium in size (length 15-40mm). Shell thin. Elongately ovate; length 1.5 times height. Somewhat compressed. Slightly inequilateral and inequivalve. Anterior and ventral margins gently convex. Posterior dorsal margin straight. Posterior narrowed and gently truncate; gaping slightly. Umbones prominent, central. Beaks opisthogyral.

Escutcheon well developed. Lunule small. Anterior carina weakly impressed. Hinge features incompletely known. Left valve with a long, lamellar tooth paralleling the antero-dorsal margin and articulating with a groove in the anterior margin of the right valve. Musculature and pallial features obscure. Ornament consisting of fine growth lines and a few irregularly spaced concentric ridges.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
F9182 GSQ	17	9	11.5	3 (1 valve)
F30490 (A) UQ	34	17	24.5	6 (")
F30491 UQ	39	19	26	5 (")

Remarks: In shape these specimens compare closely with those figured by Woods (1909, pl.40, figs 1-3) from the Lower Greensand of England as *Thracia robinaldina*? Unfortunately, neither group of specimens shows hinge features. Casey (1961c, p.607) reported the English specimens as *Periplomya robinaldina* (d'Orbigny) and gave their range as *fissicostatus* and *forbesi* Zones (lowest lower Aptian). D'Orbigny's species was among those that Conrad (1867) originally suggested might belong to his genus "*Leptomya*" (=*Periplomya* Conrad, 1870).

Thracia wilsoni Moore (1870, pl.14, fig.8) is somewhat similar, but is a larger, proportionately higher species.

Occurrence:

Minmi Member: "portion 131V, parish Bungeworgorai" (Whitehouse, 1927); RD109; L140 GSQ; L150 GSQ; L2162 UQ.

Age: Early Aptian.

Family Thraciidae Stoliczka, 1871

Remarks: This family comprises more or less oblong shaped, very thin, cellulo-crystalline shells which have a rather earthy appearance, are inequivalve, possess a well developed pallial sinus, lack teeth and have a sub-external or almost internal ligament seated on a chondrophore developed on the postero-dorsal margins.

The Thraciidae, which arose in the Triassic, are well represented in modern seas.

Genus *Thracia* Leach, (in Blainville) 1824

Type species (by subsequent designation Blainville, 1827, p.660): *Thracia corbuloidea* Blainville, 1824, Recent, Mediterranean Sea.

Generic diagnosis: Shell thin. Transversely ovate to ovately trigonal; broadly rounded anteriorly; truncate and gaping posteriorly. Right valve larger and more inflated than the left. Umbones broad, slightly in front of mid-length. Beaks slightly opisthogyral. Hinge without teeth. Left valves sometimes with a small, sub-umbonal ossicle or tubercle at the anterior extremity of the ligament pit. Ligament short, mostly internal, attached to spoon-shaped modifications of the postero-dorsal margins. Muscle scars and pallial features usually difficult to observe owing to the extreme thinness of the shell. Pallial sinus moderately deep. Ornament consisting of concentric wrinkles, concentric growth lines and surficial granulation.

Range: Triassic-Recent.

Remarks: The genus *Thracia* has been broadly interpreted to include most thraciids of Mesozoic and Tertiary age as well as living species. Recently Hayami (1966, p.171) has utilized the generic name *Corymya* Agassiz, long considered a synonym of *Thracia* by many workers, for posteriorly carinate Jurassic and Cretaceous thraciids. *Thracia wilsoni* Moore and *Thracia primula* Hudleston described below have virtually external ligaments, thus recalling species of the Recent Australian genus *Eximothracia* Iredale (1924). In living species of *Thracia*, the ligament is largely internal. However, until more and better preserved material is available these species are retained in *Thracia* s.l.

Thracia wilsoni Moore, 1870

Pl.43, figs 11-12

Synonymy:

1870 *Thracia wilsoni* Moore, p.254, pl.14, fig.8.

1892 *Corimya wilsoni* (Moore); Etheridge Jnr, p.481, pl.28, fig.10.

1925 *Thracia wilsoni* Moore; Whitehouse, p.31.

?1927 *Thracia* cf. *wilsoni* Moore; Whitehouse, p.146.

?1964 *Thracia wilsoni* Moore; Day, table 3,

Type: Lectotype: Herein designated as the specimen figured by Moore (1870, pl.14, fig.8) and refigured by Etheridge Jnr

(1892, pl.28, fig.10). Ludbrook (1966) reports that Moore's type is still extant and is housed in the British Museum (Natural History). Locality: "Amby River", probably from Doncaster Member, upper Aptian.

Material: Two reasonably well preserved right valves, an internal mould of a right valve and 6 fragmentary specimens.

Specific diagnosis: Transversely elongate, well inflated *Thracia* with a slightly sloping antero-dorsal margin; length about 1.3 times height; umbones prominent; carina indistinct.

Description: Medium to large in size (length 30-80mm). Thin shelled. Well inflated. Transversely ovate. Slightly inequilateral. Antero-dorsal margin almost straight, sloping fairly steeply, and merging imperceptibly with the gently rounded anterior margins. Postero-dorsal margins straight, slightly sloping. Ventral margins broadly rounded. Posterior narrowed, truncate; possibly gaping. Umbones prominent, central. Beaks opisthogyral. A faint carina extends from the umbones towards the middle of the posterior margin. Hinge features not observed. Ligament virtually external, opisthodetic. Anterior adductor scar not observed. Posterior adductor scar large, situated near the junction of the antero-dorsal and posterior margins. Pallial line with a wide, fairly shallow sinus. Exterior ornamented with fine, fairly regularly spaced, concentric ribs and fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Lectotype*	70	34	54	-
CPC9236	78	40	58	12 (1 valve)
CPC9235	46	22	36	10 (")

*(measured from the figure of Etheridge Jnr, 1892, pl.28, fig.10).

Remarks: The lectotype of Thracia wilsoni is a left valve which was poorly figured by Moore (1870, pl.14, fig.8). Etheridge Jnr (1892, pl.28, fig.10) provided a better illustration of this specimen.

Thracia wilsoni Moore resembles T. primula Hudleston (1890, p.245, pl.9, fig.7), but the latter is more compressed, is distinctly carinate, and has less prominent umbones.

As noted by Whitehouse (1925, p.31) Thracia wilsoni is related to T. phillipsi Roemer from the Hauterivian of Europe. Specimens described from Speeton, England, by Woods (1909, p.240, pl.39, figs 7-9) are especially similar, differing only in their more sloping postero-dorsal margins.

Occurrence:

Minmi Member: "Clerk's Creek crossing"? (Whitehouse, 1927); RD109?; RD128?; L153 GSQ?

Doncaster Member: "Amby River and Bungeworgorai Creek" (Moore, 1870); GAB1031?; GAB1075?; SB116; SB117; SB129; SB130?

Maryborough Formation: "Maryborough" (Whitehouse, 1925).

Age: Early - late Aptian.

Thracia primula Hudleston, 1890

Pl.43, fig.10

Synonymy:

1890 Thracia primula Hudleston, p.245, pl.9, fig.7.

1892 Corimya ? primula (Hudleston); Etheridge Jnr, p.481, pl.28, fig.11.

1902a Corimya ? primula (Hudleston); Etheridge Jnr p.36.

1902b Corimya ? primula (Hudleston); Etheridge Jnr, p.38, pl.3, figs 8-9.

1925 Thracia primula Hudleston; Whitehouse, p.31, pl.1, fig.5.

1964 Thracia primula ? Hudleston; Day, table 3.

1966 Thracia primula Hudleston; Ludbrook, p.168, pl.21, fig.4.

1966 Thracia primula Hudleston; Skwarko, p.117, pl.13, fig.3.

1967b Thracia primula Hudleston; Day, p.24, pl.4, figs 4-5.

Types: Lectotype and Paralectotype: L9706 BMNH. Locality: "Primrose Springs", Maree Formation, Aptian or Albian.

Material: Two specimens with closed valves and ten internal and external moulds of separated valves.

Specific diagnosis: Elongately oval, weakly inflated Thracia with sloping postero-dorsal margins; umbones not prominent; carina distinct.

Description: Medium sized (length 30-60mm). Thin shelled. Elongately oval. Weakly inflated. Slightly inequilateral. Right valve slightly larger and more inflated than the left. Anterior rounded. Ventral margins broadly convex. Postero-dorsal margins straight, sloping. Posterior obliquely truncate. Umbones central, not prominent. Beaks opisthogyral. Posterior carina very distinct. Hinge features obscure in this material. Ligament virtually external, opisthodetic. Musculature and pallial characters not observed. Ornament consisting of irregularly spaced, broad, concentric ribs and fine concentric growth lines.

Dimensions: (mm)	Length	Anterior length	Height	Inflation
Lectotype L9706 BMNH	42	-	31	12
Paralectotype L9706 BMNH	48.5	-	36	15
F1341 GSQ	59	29	52	4 (1 valve)
F7841 GSQ	43	21	34	9
CPC9296	35	17	26	3 (1 valve)

Remarks: The distinction of *Thracia primula* Hudleston from *T. wilsoni* Moore has been discussed above. *Thracia primula* also appears to be longer ranged than *T. wilsoni*, as specimens from the Minmi Member (lower Aptian) are indistinguishable from those from the Coreena Member (lower Albian).

Whitehouse (1925, p.31) cited *Thracia* sp. of Kitchin (1913, pl.8, fig.5) from the Neocomian Uitenhage beds of

South Africa as a similar species, but remarked that the genus was one of limited variation and species from many horizons might be compared.

Occurrence:

Minmi Member: "Minmi near Roma" (Etheridge Jnr, 1892); Clerk Ck, 1-1/2 miles below junction with Bindango Creek; RD26; RD207; RD283?; SB264.

Coreena Member: GAB1406; GAB2087.

Maree Formation: "Primrose Springs" (Hudleston, 1890); "Peake Station" (Whitehouse, 1925); Ware 5/641/6 (Ludbrook, 1966),

Mullaman Beds: TT20 (Skwarko, 1966).

N.S.W.: "Mt Stuart run" and "Mt Brown district near Milparinka" (Etheridge Jnr, 1902b).

Age: Early Aptian - early Albian.

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