

## SOME SILURIAN LAMELLIBRANCHS FROM NEW SOUTH WALES.

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(Plate xix.)

[Read 28th October, 1959.]

## INTRODUCTION.

Lamellibranchs from the Silurian of New South Wales described in this paper are from various sources. Some were obtained from Hatton's Corner, Yass, from a bed which also contained *Monograptus nilssoni* and *M. bohemicus*. Consequently their age (Lower Ludlow) and zone (*M. nilssoni*, zone 33) are known definitely (Brown and Sherrard, 1952).

A second group was found in the Nanima-Ginninderra-Boambolo district, south of Yass. At one locality there, the common occurrence of *Cosmogoniophora*, a subgenus confined to the Silurian, determines the age (Sherrard, 1952). Elsewhere in the same district, some lamellibranchs occur in strata conformably below graptolite-bearing beds of known age, while Mr. A. J. Shearsby has collected them at Forest Creek, Boambolo.

Thirdly, there are included specimens from the Jenkins Collections of the University of Sydney Geological Department. These come from Yass beds which lie conformably below the bed with *Monograptus nilssoni* mentioned above.

A fourth group of specimens, now in the Australian Museum, was collected by John Mitchell in the Bowning district, but from localities unknown precisely. In some cases he labelled the specimens either U.T.B., M.T.B. or L.T.B. (Upper, Middle or Lower Trilobite Bed). The age of these Trilobite Beds relative to that of graptolite-bearing strata has been worked out (Brown and Sherrard, 1952, p. 130). Dr. Ida Browne (1954) considers that the Upper Trilobite Bed marks the top of the Silurian.

Fifthly, there is a large collection from the Cootamundra district (Gill, 1940), while a sixth consists of lamellibranchs from other Silurian localities in New South Wales. Both these groups are housed in the Australian Museum.

Lamellibranchs of Silurian age from New South Wales which have previously been recorded (Etheridge, 1880; De Koninck, 1898; Fletcher, 1943; Stevens, 1959) are also listed.

A study of the lamellibranchs in the first six groups given above confirms the conclusions expressed by Zittel in his introduction to the Class Lamellibranchiata (p. 502, 1913 edition). He pointed out that the Silurian was characterized by the presence of palaeoconch, taxodont and older schizodont lamellibranchs. This exactly describes these collections except for the fairly large representation of the genera *Goniophora* and *Paracylas*. Genera from other sections of the Lamellibranchiata are rare.

Lamellibranchs of simple and primitive type without a denticulated hinge grouped by Neumayr among the Palaeoconchae made almost their only appearance in abundance in the late Silurian of Bohemia and of the Eastern Alps, and the Lower Upper Devonian (Portage) of the State of New York. "These peculiar genera never appeared before or since for the most part", wrote Clarke (1903). The few representatives of such Palaeoconchae as *Slava*, *Lunulicardium*, *Paracardium*, *Panenka* in the New South Wales Silurian link it with these faunas. Barrande's perhaps unnecessarily large number of species among these lamellibranchs does not seem to have been reviewed as have his taxodonts by Pfab (1934) and some of his Aviculas by Ruzicka (1949, 1950).



Among other Palaeoconchae from the Bowning district, numerous specimens, though first referred to the genus *Leptodomus*, have finally been determined as *Grammysioides*, a subgenus of *Grammysia*, but without its characteristic fold and sulcus. Though Leriche (1912) considered the fold in *Grammysia* disappears with age and Beushausen (1895) quotes Hall as considering the transversal fold in *Grammysia* as of trifling importance, Williams and Breger (1916, p. 130) concluded, after a thorough investigation of the literature, that the name "*Grammysia*" ought to be restricted to those shells in which the fold and sulcus are developed at least in some stage of the life-history. Since these shells from Bowning under discussion in no case showed a fold, they were therefore not referred to *Grammysia*, but placed at first in *Leptodomus* because they resemble the type of *L. maccoyanus* Chapman in the National Museum, Melbourne, a specimen which Chapman tells us (1908, p. 17) was selected by McCoy, the author of the genus, as an example of *Leptodomus*. Against this allocation are the facts that McCoy established the genus for a Carboniferous fossil and that *Leptodomus* has a gaping shell, which does not seem to be the general case for these specimens. Although there are several examples in the collection from Bowning at the Australian Museum, of two valves in contact at the umbo but wide apart below, this condition may have developed after death because of the strong ligament, and cannot be taken as evidence of a gape.

Other possible ascriptions were rejected because the shells show no sign of the radial marking which characterizes *Pholadella* and *Rhytimya*. *Sphenomya* has no ligamental groove and *Sphenotus* has teeth. Opinions differ about the development of the lunule in *Cuneamya*, Williams and Breger (1916, p. 131) saying it is weak and McLearn (1924, p. 96) the opposite. Consequently these particular shells seem best placed in *Grammysioides*.

There are fewer representatives of true *Grammysia*. In these, the sulcus, though observable, is not pronounced. A *Grammysia* from Cootamundra is of use in dating the rocks from which it comes, since its characteristic fold runs from the beak to the post-ventral angle, not vertically downward from the beak. This condition is found only in *Grammysias* of pre-Devonian age (Williams and Breger, 1916, p. 136).

*Lunulicardium* is placed with the Palaeoconchae following Neumayr (Zittel, 1913, p. 437). *Palaeosolen* is also included there. Zittel, though he placed *Palaeosolen* in the family Solenidae, says "the Silurian forms heretofore referred to this family, do not seem to belong there".

Confusion has arisen in palaeontological literature over the *Ctenodonta*-*Palaeoneilo*-*Nuculites* group of Taxodont lamellibranchs, and specimens from New South Wales examined for this paper do little towards establishing clear distinctions. After the priority of Salter's genus *Ctenodonta* over Hall's *Tellinomya* was recognized (Oehlert, 1888; Beushausen, 1895), palaeontologists failed to agree as to the placing of fossils in *Ctenodonta* or in Hall's later genus *Palaeoneilo*. In synonymies listed by Mailleux (1932, 1937) the same species is seen to have passed from one genus to the other and back again more than once. Beushausen (1895) divided the genus *Ctenodonta* into several subgenera, one being *Palaeoneilo* and another *Tancrediopsis*. Clarke (1907) on the other hand made *Nuculites* a subgenus of *Palaeoneilo*. *Ctenodonta* is also confused with *Nucula* and with *Tellinites* (Williams and Breger, 1916, pp. 163, 173) as well as with *Nuculites*. Several specimens in the Sedgwick Museum at Cambridge are labelled *Ctenodonta* (? *Nuculites*). Further, *Nuculites* is generally acknowledged as synonymous with *Cleidophorus* (*Clidophorus* of some American authors) and *Cucullella*.

The main reason for these uncertainties is probably the condition of the palaeozoic fossils which are often somewhat battered casts or moulds, such as are many of those described here. The casts cannot always be entirely detached from rock matrix, so that their hinges are not completely revealed. In such cases portions of concentric growth lines near the cardinal edge can look not unlike the clavicular ridge of *Nuculites*, which is often quite short in that genus. Ulrich (1897) has referred to the difficulty in some cases of establishing the anterior end of a palaeozoic shell.



After protracted and careful study of Nuculoid shells in these collections, it has been decided that none can be separated as *Ctenodonta* except those of the subgenus *Tancrediopsis*.

Species of *Nuculites*, *Nuculana* and *Nuculopsis* have been recognized. In the case of the last, since most specimens are preserved as external casts of the two valves joined and closed, the presence of the chondrophore cannot be determined. However, Girty (1911), the founder of the genus, is not absolutely certain of its presence, saying that the taxodont teeth of his type (which is not figured) are not interrupted by it, but that it is probably below them. In any case this feature cannot always have been used in identification, since of Fleming's twenty-two type specimens of *Nuculopsis gibbosa* in Edinburgh, Schenck (1934) tells us all but one have the two valves tightly closed, as are all fifty-five in the Musée at Brussels.

The correct placing of the species described here as *Actinopterella formosa* has been difficult. It is more erect and symmetrical than other species of the genus described in this paper. Its allocation to *Aviculopecten* was thought of, but Newell (1937), who has made an exhaustive study of that genus, states that it does not occur below the Lower Carboniferous. Then its placing in the Silurian genus *Palaeopecten* was considered. Williams (1913) established this genus for *Avicula? danbyi* McCoy from the Upper Ludlow of Westmoreland. He stated that the type shell was nearly symmetrical in outline. Though he subsequently (Williams and Breger, 1916) placed *Avicula? danbyi* in the synonymy of *Follmanella* (presumably because of the backward prolongation of some specimens), one specimen of *Avicula danbyi* var. in the Sedgwick Museum is similar to *Actinopterella formosa*, n. sp., in outline and ornament. Its length and height are each 20 mm., whereas all but about six of nearly one hundred measurements of Late Palaeozoic species of *Aviculopecten* given by Newell (1937) have greater height than length. In *Actinopterella formosa* the length is the greater.

Etheridge and Dun (1906) used the word *Palaeopecten* not in the generic sense but as a collective term for pectinoids of Upper Palaeozoic age.

The terms *Modiolopsis* and *Modiomorpha* have often been used interchangeably. Williams and Breger (1916, p. 216) consider Upper Palaeozoic Modiolopsoids are dentate and therefore should be placed in *Modiomorpha*, whereas Lower Palaeozoic shells of this type are edentulous and conformable with *Modiolopsis*. However, this rule is not universally followed. *Cypricardella* which might be confused with *Modiomorpha elongata*, n. sp., from Taralga is squarer, while *Colpomya* has hinge and basal margin sub-parallel and a stronger umbonal ridge than *Modiolopsis*.

*Cyrtodonta* is included among the Schizodonta. It is referred to by Williams and Breger (1916, p. 153) as among the "schizodontic shells".

#### PREVIOUS INVESTIGATIONS.

The Silurian lamellibranchs of New South Wales have been mentioned in books and papers of the geology of the State or sections of it by W. B. Clarke, De Koninck, R. Etheridge, jnr., Jenkins, Shearsby, Sussmilch, David and Browne, John Mitchell, I. A. Brown, Fletcher, Gill and others, but systematic descriptions are rare.

De Koninck (1898) described *Pterinea ampliata* and *P. pumila* from the Silurian and *P. laminosa* and other lamellibranchs from the Devonian. However, it is possible some confusion between Silurian and Devonian specimens occurred during transit to De Koninck, because his description of *P. laminosa* is considered (Chapman, 1909) to refer to a lamellibranch abundant in the Silurian of Yass, though listed by De Koninck among the Devonian fossils. As is well known, the types of his descriptions were destroyed by fire.

From a specimen of shale of Silurian age from the Bombala district which was presented to the British Museum, Etheridge, jnr. (1880), described *Anodontopsis australis*. Among Silurian lamellibranchs in the Australian Museum collections, are slabs of shale from Yass profusely covered with badly preserved shells and labelled in



1902, possibly by Etheridge himself, *Anodontopsis australis*. This lamellibranch is almost certainly that which is commonest in the Yass beds at Yass where it is associated with the ostracod *Leperditia*. Chapman (1909), in a paper on the ostracod, referred to the lamellibranch as that which De Koninck had described as *P. laminosa*, but which was probably the early pterinoid form, *Rhombopteria*. It is described as *Rhombopteria* in this paper. When McCoy (1851) established the genus *Anodontopsis* he included in it various species which were later considered by Chapman (1908) and Williams and Breger (1916) to belong to several different genera, none of which was *Anodontopsis*.

A provisional list of lamellibranch genera from Cootamundra was given by Mr. E. D. Gill (1940) in a paper describing a trilobite from the same locality.

Mr. H. O. Fletcher (1943) has described and figured *Conocardium davidus* Dun from the Silurian of Oakey Creek, near Molong.

*Cosmogoniophora sinuosa* has been described and figured (Sherrard, 1952).

Dr. N. C. Stevens (1959) has referred to a discovery of portions of a large lamellibranch at Cooleman Caves. Through the courtesy of Dr. Stevens, I have seen this specimen. Though not certainly identifiable, it looks as if it might be related to the *Panenka-Lunulicardium* group.

#### Acknowledgements.

For the opportunity of studying lamellibranchs for this paper I am indebted to the courtesy of Professor C. E. Marshall, D.Sc., Ph.D., of the University of Sydney, and of Mr. H. O. Fletcher, M.Sc., Deputy Director of the Australian Museum. Mr. Fletcher has also been good enough to read the manuscript.

The study of specimens for comparison was kindly made possible by Professor W. B. R. King, F.R.S., of the Sedgwick Museum, Cambridge, Dr. C. J. Stubblefield, F.R.S., of the Geological Survey of Great Britain, Dr. K. P. Oakley, of the British Museum (Natural History), and Mr. E. D. Gill, B.A., Curator of Fossils, National Museum, Melbourne. Dr. Ida A. Browne has kindly advised me, and my son, W. O. Sherrard, has helped me with photography.

#### OCCURRENCES OF LAMELLIBRANCHS.

I.—On the same slabs as *Monograptus nilssoni* and *M. bohemicus* at Hatton's Corner, Yass: *Actinopterella minuta*, n. sp., very rare; *Pteronitella rugosa*, n. sp., very rare; *Cardiola* (*Slava*) *fibrosa* Sow., very rare.

Age: Lower Ludlow (Zone of *M. nilssoni*, Zone 33).

II.—Yass Series at Yass: *Rhombopteria laminosa* (De Koninck), very common; *Orthonota* sp., very common; *Ctenodonta* (*Tancrediopsis*) *victoriae* (Chapman), common; *Grammysia compressa*, n. sp., common; *Actinopterella minuta*, n. sp., rare; *A. formosa*, n. sp., rare; *Paracyclas orbiculata*, n. sp., rare; *Goniophora* sp., rare.

These are in strata conformably below beds of the zone of *M. nilssoni* (Zone 33).

III.—Middle Trilobite Bed, Bowning: *Goniophora* sp., very rare.

This bed immediately overlies the zone of *M. nilssoni* (Zone 33).

IV.—Upper Trilobite Bed, Bowning: *Nuculites pseudodeltoides* Reed, common; *Ctenodonta* (*Tancrediopsis*) *victoriae* (Chapman), common; *Grammysia* (*Grammysioidea*) *declivis*, n. sp., common; *Grammysia ampla*, n. sp., very rare; *Modiolopsis elongata*, n. sp., very rare; *Paracyclas orbiculata*, n. sp., very rare.

This bed is at the top of the Silurian (Browne, 1954).

V.—Bowning (Mitchell Collection): *Nuculites pseudodeltoides* Reed, common; *N. scissa*, n. sp., common; *Ctenodonta* (*Tancrediopsis*) *victoriae* (Chapman), common; *C. (T.) elegantula*, n. sp., rare; *C. (T.) minuta*, n. sp., common; *Grammysia* (*Grammysioidea*) *declivis*, n. sp., common; *Actinopterella lamellosa*, n. sp., rare; *A. minuta*, n. sp., rare; *Nuculopsis triangula*, n. sp., common; *Rhombopteria laminosa* (De Koninck), rare; *Lunulicardium* sp., rare; *Modiolopsis elongata*, n. sp., rare; *Paracardium* cf. *filosum* Chapman, rare; *Cypricardinia contexta* Barr., very rare.



The strata in which these occur are probably near the zone of *M. scanicus* (Zone 34).

VI.—Silverdale.

(a) Portion 36, Par. Derringullen, near Bowning: *Nuculopsis triangula*, n. sp., rare. This occurs in the same bed as *M. scanicus*.

(b) Limestone Creek, Silverdale (Fletcher, 1943): *Conocardium* sp.

This occurs in a bed immediately underlying the zone of *M. scanicus*.

VII.—Nanima-Bedulluck District (Sherrard, 1952).

(a) Nanima Trig.: *Cosmogoniophora sinuosa* Sherrard, very common; *Rhombopteria lamina* (De Koninck), very common; *Paracyclas orbiculata*, n. sp., rare.

These are probably of Upper Ludlow age.

(b) Spring Range road, Ginninderra (Sherrard, 1952): *Cyrtodonta lissa*, n. sp., very rare; ? *Nuculopsis* sp., rare.

These occur in strata conformably underlying strata with *M. testis* var. *inornatus* (Zone 31).

VIII.—Forest Creek, Boambolo, south-west of Yass: *Cyrtodonta lissa*, n. sp., common; *Grammysia compressa*, n. sp., common; *Paracyclas orbiculata*, n. sp., rare; *Grammysioidea declivis*, n. sp., rare; *Goniophora* sp.

IX.—Bowning, opposite Advance Hall: *Nuculopsis triangula*, n. sp.

X.—Barrandella Shales, Yass District.

(a) Black Range road, east of Derringullen Creek bridge: ? *Nuculopsis* sp.

(b) Wee Jasper road, 6 miles south of Yass: cf. *Mytilarca* sp.

The Barrandella shales are of Wenlock age (Brown and Sherrard, 1952).

XI.—Bombala District.—*Lunulicardium quedongensis*, n. sp.; *Anodontopsis australis* Etheridge, jnr. (1880).

Dr. Dorothy Hill (1943), who has seen in the Australian Museum, but not described, a collection of corals from the same locality as *Lunulicardium quedongensis* at Quedong near Bombala, considers "this fauna is near to or possibly identical in age with that of Yass".

XII.—Near Cootamundra.

(a) Near Cootamundra: *Nuculites scissa*, n. sp., very common; *Nuculana striata*, n. sp., very common; *Palaeosolen planus*, n. sp., very common; *Leiopteria gregaria*, n. sp., very common; *Grammysia obliqua* (McCoy), rare; *Paracyclas orbiculata*, n. sp., rare; *Tancrediopsis delicatula*, n. sp., rare; *Actinopterella* sp., rare; *Rhombopteria obliqua*, n. sp., rare.

Since *Grammysia obliqua* (McCoy) is of pre-Devonian age (Williams and Breger, 1916), this collection's age is determined.

(b) Temora road, 2½ miles from Cootamundra: *Paracardium* cf. *filosum* Chapman, rare; *Panenka cingulata* Chapman, rare; *Rhombopteria obliqua*, n. sp., rare.

Specimens of the Upper Silurian trilobite, *Gravicalymene cootamundrenis* Gill (1940) from Oak's Creek, Cootamundra, in the National Museum, Melbourne, are preserved in fine, white siltstone which seems identical with the matrix in which collection XII (b) occurs. All specimens from Cootamundra in this Museum and in the Australian Museum, Sydney, were presented by the late Mr. W. E. Williams of Cootamundra.

XIII.—Taralga: *Modiolopsis elongata*, n. sp.

XIV.—Oakey Creek, near Molong: *Conocardium davidus* Dun (Fletcher, 1943).

XV.—Dangalong, 14 miles east of Cooma: *Pterinea ampliata* De Koninck (1898).

The age is given as Llandovery by De Koninck.

The Yass and Bowning assemblages of lamellibranchs recall those recorded from Melbournian and Yeringian localities in Victoria, while there is a striking similarity between the list of genera recorded from Yass and Bowning and that from the Upper Ludlow of Woolhope, England (Reed, 1927), and to a less extent to that from Builth



(Straw, 1937) and from Arisaig, Nova Scotia (McLearn, 1924). The Cootamundra assemblage recalls somewhat that from the Devonian locality at Buchan Caves, Victoria (Talent, 1956).

Just as Hind (1910) wrote of Silurian lamellibranchs from Girvan, Scotland, it has been asserted that Australian faunas from the Silurian have a Devonian aspect, but wider collecting will be necessary before an authoritative statement can be made on this question so far as the lamellibranchs of New South Wales are concerned, since, apart from the collections from Cootamundra and a few of the species from the Yass-Bowning district, their occurrence is sparse. There would seem to be a facies control of the preservation in abundance of individuals. It is noticeable that lamellibranchs which are found prolifically in the Silurian of New South Wales occur in mudstones or siltstones where they may be piled and even crushed on top of one another. In a sandy facies, however, they are generally found singly.

The fossils occur most commonly as external casts (steinkerns), that is, reproductions in infilled material of the external shapes of the original shell on which the external markings have often been impressed through the shell. Very rarely fragments of the external shell remain on this cast also. The external casts may be detached from rock matrix or not. Less commonly the mould is preserved, that is, the hollow in which the fossil once rested and on which the external markings are shown.

#### SYSTEMATIC DESCRIPTIONS.

##### PALAEOCONCHA.

##### Genus GRAMMYSIA De Verneuil.

##### GRAMMYSIA OBLIQUA McCoy, 1855. (Pl. xix, fig. 12.)

British Palaeozoic Fossils, p. 182 and Pl. xvii, fig. 2, Mem. Geol. Soc. G.B.

Cast and mould of exterior of right valve; inequilateral, cylindrical, rather flat. Umbo prominent in anterior third. Narrow distinct fold passes from umbo to post-ventral angle. A fold in this position instead of in the usual position for *Grammysia* which is from the umbo to the centre of the ventral margin is only found in *Grammysias* of pre-Devonian age (Williams and Breger, 1916, p. 136), and can be seen in McCoy's type from Llangibby Castle, Usk, Wales, Specimen No. 24101, Geol. Surv. Great Britain Collection. In the specimen under description there is a faint sinus in the ventral margin behind the fold. Regular concentric growth lines (2 to 1 mm.) pass across valve uninterrupted by fold. Lunule and escutcheon present. Anterior adductor scar present but not posterior. Length 12 mm., height 6 mm.

*Locality*: Cootamundra.

McLearn (1924) illustrates *Grammysia obliqua*, Stonehouse formation, Arisaig, Nova Scotia, with a similar fold. The plate of *G. obliqua* from near Edinburgh (Lamont, 1954) does not resemble *G. obliqua* from Cootamundra.

##### GRAMMYSIA AMPLA, n. sp. (Pl. xix, fig. 1.)

*Holotype*: Australian Museum No. F48878.

Cast of one left valve, inequilateral, ovate; dorsal margin nearly straight, anterior margin curved, ventral margin straight except for sinus at post-ventral angle where fold emerges, posterior margin rostrate. Umbonal slope low. Umbo near anterior-dorsal angle, not prominent. Rather indistinct sulcus passes from umbo to post-ventral angle. Concentric growth lines on body of valve only seen in a band about 5 mm. wide parallel to ventral margin, though better developed on post-cardinal slope. Lunule and escutcheon present. Muscle scars not seen. Length 32 mm., height 20 mm., depth 4 mm.

*Locality*: Upper Trilobite Beds, Chapman's Selection, Bowning.

Though this species has an oblique fold like *G. obliqua*, the two species differ greatly in size and ornament. *G. ampla* resembles *Cuneamya holmesi* Lamont (1954) from near Edinburgh.



## GRAMMYSIA COMPRESSA, n. sp. (Pl. xix, fig. 3.)

Holotype: Sydney University Geological Department No. 8572.

External casts of both valves joined. Equivalve, inequilateral. Anterior end truncated but broad, posterior narrow and rostrate. Prominent well-rounded slope from umbo to post-ventral angle. Ventral margin with shallow concave sinus. Umbones almost terminal, curved over and meeting across hinge-line. Very slight indication of fold from umbo to centre of ventral edge. Ornamented by very strong concentric ribs, 6 per cm. Well-developed lunule and escutcheon. Valves appear to gape slightly at anterior and posterior ends, but this may have taken place after death. No internal features can be seen. Length 30 mm., height 18 mm., depth 7 mm.

*Locality*: Yass Beds, Yass.

This species can be compared with *G. arcuata* Conrad.

## Subgenus GRAMMYSIOIDEA Williams and Breger.

## GRAMMYSIOIDEA DECLIVIS, n. sp. (Pl. xix, figs. 2, 15.)

Holotype: Australian Museum No. F27901.

Equivalve, inequilateral, trigonal shape. Posterior wider than anterior end. Anterior-cardinal angle bent back towards umbo forming strongly marked lunule. Ventral margin slopes downward towards posterior angle with more or less well-developed sinus. Posterior margin truncated. Hinge line long and slightly arched. Umbones in anterior third, prosogyrate, very prominent, in contact over pronounced ligamental furrow along hinge line. Strongly developed rounded ridge runs from umbo to post-ventral angle with almost concave furrow between it and dorsal margin. No internal features can be described as all specimens are external casts. Hinge edentulous. Ornament: well-marked concentric ridges, uninterrupted by a sulcus. Length 20 mm., height 14 mm., depth 3 mm.

*Locality*: Bowning.

## Genus PALAEOSOLEN Hall.

## PALAEOSOLEN PLANUS, n. sp. (Pl. xix, fig. 4.)

Holotype: Australian Museum No. 32976.

Preserved as moulds and casts, single and joined. Possibly distorted by flattening. Transversely elongate, very inequilateral, equivalve. Cardinal and basal margins nearly parallel and equal. Posterior margin truncate, anterior margin with pronounced flare and re-entrant notch, causing gape about half-way between cardinal and ventral margins. Inside cardinal edge is a flattened strip widening to 1 mm. at post-cardinal angle. Concentric striae parallel to posterior and ventral margins and gathered tightly into anterior notch. More prominent striae at 1 mm. intervals with several finer in between. Low umbo at anterior tenth. Low carina from umbo to posterior-ventral angle. Length 30 mm., height 10 mm., depth about 2 mm.

*Palaeosolen planus* resembles the plate of *P. simplex* Clarke (Clarke, 1907) and also specimen No. 7869, National Museum, Melbourne, *Orthonota australis* Chapman.

*Locality*: As for *Grammysia obliqua*.

## Genus ORTHONOTA Conrad.

## Cf. ORTHONOTA sp.

Numerous casts of joined valves, extremely poorly preserved. Tumid. Rectangular outline, elongated, dorsal and ventral margins nearly parallel. Posterior margin truncated. Prominent post-umbonal slope. Umbo depressed, at anterior third. Suggestion of concentric growth lines. Length 20 mm., height 8 mm., depth 3 mm.

*Locality*: Yass Beds; Cliftonwood, Portion 100, Par. Yass.

## Genus PANENKA Barrande.

## PANENKA CINGULATA Chapman. (Pl. xix, fig. 5.)

One left valve preserved as a mould of the external surface. Regularly triangular in shape. Posterior edge concave, anterior covered. Ventral margin evenly rounded. Surface of shell undulatory. Convex near umbo and concave near ventral margin.



Umbo fairly prominent, gibbous. About 16 regularly rounded deeply indented radial ribs pass from umbo to central margin. These are crossed by about three indefinite, concentric undulations. Length 15 mm., height 10 mm., depth 3 mm.

*Locality*: Cootamundra.

Genus LUNULICARDIUM Munster.

LUNULICARDIUM QUEDONGENSIS, n. sp. (Pl. xix, fig. 6.)

Holotype: Australian Museum No. F23306.

External cast of valve of which one side is obscured by limestone matrix, apparently trigonal outline and inequilateral, very convex with triangular reflexed flange near post-dorsal angle cutting off posterior margin. Umbo somewhat broken, apparently sub-central and strongly gibbous, overhanging hinge-line. Strongly marked radial ribs, 5 in 10 mm., about 0.1 mm. deep, seen most prominently over central and ventral region, not near umbo. Intercalation of extra ribs seen near ventral margin. Faint chevron-shaped concentric markings on flange and neighbouring portions of shell. Development of granules seen in remaining fragment of external shell. No internal characters can be seen. Some authors, including Munster, the founder of the genus, consider the flange is developed to the anterior of the beak, becoming a lunule. Length 40 mm., height about 30 mm., depth 19 mm.

*Locality*: Quedong, near Bombala.

Genus CARDIOLA Broderip.

Subgenus SLAVA Barrande.

CARDIOLA (SLAVA) FIBROSA Sow. (Pl. xix, fig. 13.)

One valve (left) external cast, oval outline continuous except along hinge-line which is shattered. Umbo broken but apparently nearly central. Very strongly marked concentric ridges, separated by grooves, the valve thus being divided into five low steps, each of which is slightly arched and about 3 mm. wide at greatest width, but closer together near cardinal margin. Faint, discontinuous rounded radial striae, 2 mm. apart, more strongly marked over erect body. Between each radial, three series of pores. Neither muscular impressions nor pallial line detectable. Length 12 mm., height 16 mm., depth 2 mm.

This specimen closely resembles British Museum specimen No. L28844, *Slava* aff. *bohemicus* from F1, Kosor, with which it has been directly compared, and is of much the same size. L28844 is labelled "a juvenile form". *Slava imperficiens* Barr. (283, Taf. III, Heritsch, 1929), Kokberg, Eastern Alps, is similar. *Slava fibrosa* when adult shows a fringe of fine radiating striae just inside the ventral margin. This cannot be seen on the Yass specimen, though curiously enough the lamellibranch overlies on one side a nautiloid which shows just this ornament. Barrande says young *Cardiola fibrosa* have no fringe.

*Locality*: Hatton's Corner, Yass. On slab with *Monograptus bohemicus*.

Genus PARACARDIUM Barrande.

PARACARDIUM cf. FILOSUM Chapman. (Pl. xix, fig. 14.)

Preserved as right valve, thin-shelled. Anterior and posterior edges slope almost equally with long regular convex ventral margin. Shell nearly flat. Umbo depressed, central. Prominent radial striae from near beak to ventral edge which is denticulate. Radial striae more strongly impressed near ventral margin than dorsally. Radii crossed by poorly defined concentric rugosities, 2 mm. apart. No internal characters visible. Length 11 mm., height 12 mm., depth 2 mm.

*Locality*: Bowning.

Genus TELLINOPSIS Hall.

TELLINOPSIS FLABELLIFORMIS, n. sp. (Pl. xix, fig. 18.)

Holotype: Australian Museum No. F29393.

Material: One well-preserved valve retaining a small portion of its smooth, external surface. Undistorted, almost isosceles triangle with dorsal margin very slightly arched



at umbo making greatest length of valve. Pronounced folds from umbo to both antero-dorsal and post-dorsal angles leave depressions between the folds and the dorsal margin which slopes from the umbo to the antero- and post-dorsal angles. Almost unbroken curve around anterior, ventral and posterior margins interrupted only by slight emarginations. Umbo nearly central and prominent above hinge, over which it protrudes very slightly. It is difficult to determine in which direction the umbo points. Williams and Breger (1916), in describing *Tellinites* (equivalent to *Tellinopsis*), say the umbo is directed vertically, which seems to be the case here. Discontinuous concentric striae, about 1.5 mm. apart, are noticeable near the ventral margin, but not on the body of the shell. Faint suggestion of radial markings. Muscle scars and pallial line cannot be seen. Hinge without teeth and with distinct external groove presumably for ligament. Length 27 mm., height 14 mm., depth 4 mm.

*Locality*: Bowning.

#### TAXODONTA.

Genus CTENODONTA Salter.

Subgenus TANCREDIOPSIS Beushausen.

TANCREDIOPSIS VICTORIAE (Chapman). (Pl. xix, fig. 7.)

*Palaeoneilo victoriae* Chapman, 1908, 33; Pl. III, figs. 47-49.

Material preserved in various ways: as casts of both valves in contact or of both valves joined only at umbo and splayed out by pressure; as single valves remaining in rock matrix, also as a mould. Most of these are distorted by pressure from above or from both sides until some valves in contact are flattened to wafers. Undistorted shells are equi-valve, inequilateral, of cylindrical shape with posterior section about  $1\frac{1}{2}$  times length of anterior section; while anterior is nearly twice as wide as posterior, so that ventral margin slopes posteriorly upward with sometimes a concave flange bounding its edge. Posterior margin rostrate, anterior rounded. From the umbo an almost angular ridge runs to the postero-ventral angle bounding a large escutcheon above it. Umbones nearly central, depressed, not full, prosogyrate, curving inward over hinge-line. Ornamented by very strongly marked concentric ridges (12 in 5 mm.), rounded. These are less prominent towards the ventral edge. Ligamental groove. Muscular impressions and pallial line cannot be seen. Prominent taxodont teeth, 2 per mm., evenly spaced and equal in size on posterior and anterior sides of umbo, none beneath it, half-moon shaped with open end towards umbo. Length 23-19 mm., height 10-8 mm., depth 2-3 mm.

*Locality*: Yass and Bowning, common in both Yass and Hume Beds.

By comparison with the holotype of *Tancrediopsis victoriae* (Chapman) No. 7915 National Museum, Melbourne, specimens from Yass and Bowning can be identified as conspecific.

Reed (1931) figures *Tancrediopsis ludensis*, sp. n., from the Lower Ludlow of the Ludlow district of England, drawing attention to its alliance to *T. victoriae* (Chapman). McLearn (1924) compares his *T. altistriata* from Ross Brook formation, Arisaig, Canada, with *T. victoriae* (Chapman) also. Mailleux's (1937) plates of *Palaeoneilo maureri dunensis* Beushausen from Lower Devonian of Belgium are also comparable with *T. victoriae* from Yass.

TANCREDIOPSIS DELICATULA, n. sp. (Pl. xix, fig. 20.)

Holotype: Australian Museum No. F27931.

Similar oval outline to *T. victoriae* with anterior margin rounded and posterior margin rostrate. Umbo at anterior third. Post-umbonal ridge prominent, rounded. A flange swings round outer margin from cardinal-anterior angle and is doubled back into a furrow round ventral margin. Ornament: very fine delicately etched concentric striae about 10 to millimetre. Length 11 mm., height 5 mm., depth 1 mm.

*Locality*: Bowning.



## TANCREDIOPSIS MINUTA, n. sp. (Pl. xix, fig. 16.)

Holotype: Australian Museum No. F29429.

There are a number of these small shells which scarcely differ from *T. victoriae* except in size and proportion of height to length. Length of type 10 mm., height 6 mm. *T. lauta* McLearn is similar, though narrower.

Locality: Bowning.

## Genus NUCULITES Conrad.

## NUCULITES PSEUDODELTOIDES Reed. (Pl. xix, fig. 17.)

Material preserved in casts and moulds of single valves, some crushed others undistorted. Equivalve, slightly inequilateral, nearly circular margin, but cardinal margin somewhat flattened towards posterior angle because umbonal slope falls to a furrow before reaching cardinal margin. Anterior and ventral margins rounded, posterior margin slightly rostrate. Umbones central, slightly raised above cardinal margin, would just meet if two valves preserved in contact. Slope from umbo to all margins smoothly convex. Faint concentric striae near ventral margin, six per millimetre. Anterior adductor scar distinct, large, anterior to clavicular ridge, close to ventral margin, rather deep; posterior adductor scar indistinct. Pallial line simple. Very short clavicular ridge, about one-fifth height of shell. Many taxodont teeth which can be seen to continue beneath the beak in some specimens and which increase in size away from umbo. Teeth in form of acute angles with the apices directed anteriorly as is characteristic of *Nucula applanans* Barrande according to Pfab (1934), now *Ctenodonta applanans*, an Ordovician species. Length 17 mm., height 13 mm., depth 3 mm.

Locality: Bowning.

Undoubtedly the distinction between these shells and *Ctenodonta* is very slight, since the clavicular ridge is so short and shallow. Clarke refers (1907, p. 232) to a species of *Nuculites* with only the "barest indication of an anterior clavicle", while Reed (1927), in comparing his *Nuculites pseudodeltoides* with the holotype of *Nucula deltoidea* Phillips, adds "there seems no clavicular ridge". Nevertheless, the plate of *N. deltoidea* Phillips (Mem. Geol. Surv. G. Brit., II, 1848, Pl. XXII, 5) is very like the Bowning specimens of *N. pseudodeltoides*.

## NUCULITES SCISSA, n. sp. (Pl. xix, fig. 19.)

Holotype: Australian Museum No. F27897.

Preserved in sandstone and siltstone as casts and moulds of left and right valves. Holotype, cast of a right valve. Inequilateral, equivalve, cylindrical. Cardinal margin arched; anterior rounded, ventral slightly indented by wide shallow sinus; posterior, rostrate. Posterior and anterior ends of about equal width. Post-umbonal slope very prominent, making shell almost cylindrical. Low umbones at anterior third, protrude slightly above hinge. Faint concentric striae near ventral margin, scarcely visible on umbonal slope. Small distinct adductor impressions seen on some moulds. Pallial line faint. Prominent vertical clavicular slit at anterior end of cast (ridge on moulds), strong ligamental furrow seen on some casts. Series of taxodont teeth, V-shaped with acute angle directed anteriorly. Holotype length 12 mm., height 7 mm., depth 4 mm. of one valve.

Locality: Upper Beds, Bowning.

Specimens of *Nuculites* from Cootamundra are sometimes considerably larger than those from Bowning, being more than 20 mm. long in some cases, but many of them are shattered and enlarged by squashing and being packed on top of each other. Since some relatively undamaged moulds from this locality agree closely with the holotype, all are included in this species.



Genus *NUCULOPSIS* Girty.*NUCULOPSIS TRIANGULA*, n. sp. (Pl. xix, fig. 21.)

Holotype: Australian Museum No. F29410.

Trigonal outline, slightly inequilateral, equivalve; dorsal margin slightly arched, passing by sharp angle at either end to convex posterior and anterior margins. Ventral margin also convex. Shell tumid. Both ends of equal height. Umbones very prominent, prosogyrate, pointed, central to one-third distance from anterior; nearly in contact over narrow area, swollen. Trace of external ligamental groove. Faint concentric striae seen near ventral margin. Pallial line simple, small raised adductor muscles, taxodont teeth sometimes seen, as in mould from Portion 36, Par. Derringgullen. Length 10 mm., height 8 mm., depth 3 mm.

Locality: Bowning.

*Otenodonta chapmani* Opik (Opik, 1953, Pl. VI, fig. 37), Heathcote, Victoria, seems similar to *Nuculopsis triangula*, n. sp., in shape, but is smaller.

Genus *NUCULANA* Link.*NUCULANA STRIATA*, n. sp. (Pl. xix, fig. 22.)

Holotype: Australian Museum F32995.

Preservation in large numbers as casts and moulds of single valves. All are small, with the largest about 15 mm. long and 6 mm. high, and ranging down to 6 mm. long and 4 mm. high. Valves often shattered by flattening, but apparently originally equivalve, inequilateral. Undamaged external casts show somewhat swollen valves. Elongated posteriorly to rostrate projection. Ventral and anterior margins rounded. Cardinal margin in low arch. Posterior end narrower than anterior. Rounded umbonal-posterior ridge sloping in one direction to cardinal margin and in other to slight hollow which makes sinus on ventral margin. Umbones not prominent, internal moulds suggest opisthogyrate character; nearly central, but slightly anterior. Small, squarish posterior adductor scar rather deeply excavated. Small pallial sinus. Small, regular, taxodont teeth which are interrupted at the centre as can be seen in some specimens. Strongly marked concentric striae, about 0.6 mm. apart, with more finely marked striae between them.

*N. striata* is extraordinarily like plates of *Leda acuta* in Gardner (U.S.G.S., Prof. Pap. 142, 1926, Pl. II, figs 13-16) which is Tertiary.

Locality: As for *Grammysia obliqua*.

## SCHIZODONTA.

Genus *RHOMBOPTERIA* Jackson.*RHOMBOPTERIA LAMINOSA* (De Koninck). (Pl. xix, fig. 25.)*Pterinea laminosa* De Koninck, 1898.

Neotype: Sydney University Geological Department No. 8570.

Preserved in sandy matrix as external and internal casts and moulds of single valves. Shells are often crowded together so that they have become cracked and distorted by flattening. Inequilateral, inequivalve, left valve has a low, oblique and convex umbonal slope from cardinal to ventral margin. Right valve flat to resupinate, though this may be partly due to pressure. Body oblique, about 15 degrees to vertical. Large, triangular posterior ear, very small anterior ear. Hinge-line horizontal posteriorly, then slightly arched, less than greatest length of shell. Very shallow sinuses sometimes seen below antero-cardinal angle and more rarely below post-cardinal angle, beneath which anterior, posterior and ventral margins form an unbroken convex curve. Surface of posterior ear concave as seen in internal mould, separated from body of shell by pronounced ridge. Umbo in anterior quarter, scarcely projects above hinge. Low and blunt. Ornament: Angular, concentric lamellar folds (2-3 per mm.) seen in fragment of external shell. Moulds and casts also show irregular, concentric laminations and a few, faint broken radial striae. The rough



surface produced by these folds makes the detection of adductor scars almost impossible. Ligamental area narrow groove, strongly striated at right angles to its length by growth lines. Small raised grooves slightly behind the umbo may represent posterior lateral teeth. Length 18 mm., height 18 mm., depth about 2 mm.

*Locality:* Yass Beds, Yass.

*Rhombopteria laminosa* is undoubtedly difficult to distinguish from *Leiopteria gregaria* except for the resupinate right valve of *Rhombopteria*.

RHOMBOPTERIA OBLIQUA, n. sp. (Pl. xix, fig. 26.)

Holotype: Australian Museum F32985, F32986 (counterparts).

Well-preserved, undistorted cast and mould of left valve. Inequilateral, oblique body 20 to 40 degrees from vertical. Slightly developed anterior and posterior ears separated by very shallow sinuses from otherwise uninterrupted convex curve round anterior, ventral and posterior margins. Umbones gibbous, projecting strongly over hinge-line at anterior third. Pronounced ridge from umbo to ventro-posterior angle. Hinge-line interrupted by prominent umbo. No ligamental groove. Large shallow anterior adductor scar connected by faint pallial line to rectangular posterior scar on wing. Strongly marked concentric lamellar growth lines 1 mm. apart on body of shell, but bunched closely together on dorsal margin near anterior and posterior angles. A few interrupted radial ridges near ventral margin. Length 10 mm., height 10 mm., depth 4 mm.

These shells have not the large posterior wing, completely separated anterior wing and ligamental groove of *Leiopteria*, nor the continuous radial striae of *Actinopterella*. They have not the circular outline of *Megambonia*. They resemble Clarke's (1903) plate 12, figs. 1-8, of *Posidonia mesacostalis*. Weigelt (1922; in Kegel, 1925) asserts that *Posidonia* is a synonym of *Rhombopteria* and results from a special facies.

*Locality:* As for *Grammysia obliqua*.

Genus ACTINOPTERELLA Williams.

ACTINOPTERELLA MINUTA, n. sp. (Pl. xix, fig. 23.)

Holotype: Australian Museum No. F48880; right valve No. F29403.

Several well-preserved left and one right valves. External moulds and casts. Both valves convex, straight hinge-line which is greatest length of shell. Relatively large, slightly convex upward, posterior ear marked off from body of shell by furrow. Anterior ear is small, more convex than posterior, and is separated from anterior margin by sinus and from body of shell by furrow. Posterior margin is concave with comparatively large sinus marking off ear. Ventral margin rounded. Slope continuous from umbo to post-ventral angle. Body oblique, between 30 and 50 degrees to vertical. Prominent umbo rising slightly above hinge-line at anterior third. About 30 to 35 strongly marked rounded radial ribs on body and sometimes on posterior ear of left valve but not on anterior ear. On right valve very faint radial ribs at ventral margin of body and on posterior ear. About 20 concentric lamellae occur distinctly on anterior ear and the anterior section of body, especially of left valve, but very faintly on posterior ear. These are less well developed than the radial striae. Well-marked byssal sinus. Narrow ligamental area. Neither muscular impressions nor pallial sinus can be distinguished. Posterior lateral tooth parallel to and just below ligamental area. Two small cardinal teeth in front of umbo. *Actinopterella minuta* resembles closely in appearance and size Barrande's plate of *Avicula* ? *Pterinea migrans* (Vol. VI, Pl. 229, fig. XII, 1-12) which Ruzicka (1950) names *Leiopteria* (*Actinopteria*) *migrans migrans* from Zone e gamma (Zone of *Monograptus hercynicus* and *M. uniformis*). Ruzicka refigures it on Tab. I, Pl. I (18), fig. 5. Also comparable with *Actinopterella minuta*, n. sp., are *Actinopteria communis* (Maryland Geol. Surv. Dev., Pl. LXXVI, fig. 4) and *Actinopterella peninsularis* from the Devonian (La Rocque, 1950). Length 9 mm., height 6 mm.

*Locality of Holotype:* Hatton's Corner, Yass (Zone of *Monograptus nilssoni*).



## ACTINOPTERELLA LAMELLOSA, n. sp. (Pl. xix, fig. 9.)

Holotype: Australian Museum No. F2750.

Left valves poorly preserved. Anterior ear cannot be seen. Hinge-line not greatest length of shell. Body very convex, posterior ear less convex than body. Body oblique, about sixty degrees to vertical. Umbo raised 5 mm. above cardinal line, directed anteriorly. Concentric lamellar wrinkles, radiating striae, rounded in groups of two, with furrow between. Ornamentation strongest on body, very faint on posterior ear. Body too oblique for *Limoptera*, for which it might otherwise be taken. Length 25 mm., height 25 mm., depth 8 mm.

Locality: Bowning.

## ACTINOPTERELLA FORMOSA, n. sp. (Pl. xix, fig. 28.)

Holotype: Sydney University Geological Department No. 8571.

One left valve, external cast, well preserved, undistorted. Straight hinge-line, well-developed anterior and posterior ears, the latter twice the size of the former. Anterior ear very slightly convex upward, separated from the body of shell by radial furrow. Posterior ear flat. Outline nearly semi-circular except for shallow relatively large sinus on anterior margin beneath ear. Body nearly erect and almost flat. Umbo depressed, below hinge-line at anterior third. Rounded radial costae on body (except on umbo) and posterior ear, not on anterior ear except along margin. Around margin 48 costae on body, 24 on posterior ear having increased by bifurcation on both and apparently by implantation also on body. Less prominent concentric rugosities (fila of Newell) 3 per mm., which are continued on to both ears. Small deep posterior muscle scar(?) can be detected. Narrow ligamental area with discontinuous longitudinal ridges. Length 18 mm., height 14 mm., depth 1 mm.

Locality: Yass Beds, Yass.

*Actinopterella minuta* occurs on the same slab. *A. formosa* resembles *Actinopteria boydi* (*Actinopterella* according to Williams and Breger, 1916) from the Yeringian of Victoria (Chapman, 1908, Pl. V, fig. 70), but is not so deep.

## Genus PTERONITELLA Billings.

## PTERONITELLA RUGOSA, n. sp. (Pl. xix, fig. 8.)

Holotype: Australian Museum No. F48881.

One right valve, external cast, slightly convex over body, well preserved, undistorted, inequilateral. Posterior wing flat, anterior with very low arch, separated from body by furrow. Almost perfect semi-circular outline of shell made by almost continuous curve round posterior, ventral and anterior margins with very slight sinuses below both postero-cardinal and antero-cardinal angles. Hinge-line greatest length. Anterior wing small and posterior wing large. Umbo at anterior third, very low and depressed, rises 0.25 mm. above hinge. Body nearly erect, about 10 degrees from vertical, falls in low slope to ventral margin, not resupinate.

Ornament: Concentric, rough, raised lamellae, irregular, not continuous, faint radial striae stronger over body section, where they are about 0.5 mm. apart, hardly visible on posterior and anterior sections, about 2 mm. apart on ventral margin. This radial striation is known on *Pteronitella*, though rarely (Williams and Breger, 1916, p. 193). External ligamental area, narrow, 0.1 mm. wide, well developed posteriorly. One posterior lateral tooth nearly parallel to (5 degrees to horizontal) and close to hinge, between two grooves, extending half distance between umbo and postero-cardinal angle. Neither cardinal teeth nor muscle scars visible. Length 11 mm., height 7 mm., 1 mm. deep.

Locality: Hatton's Corner, Yass, associated with *Monograptus nilssoni* and *M. bohemicus*.

Remarks: *P. rugosa* can be compared closely with the figure of *Pterinea condor* Salter from the Lower Ludlow of Dudley, England, though *P. rugosa* is much smaller, *P. condor* is now taken as a *Pteronitella* (Reed, 1902, 1927).



Genus *LEIOPTERIA* Hall.*LEIOPTERIA GREGARIA*, n. sp. (Pl. xix, figs. 24, 31.)

Holotype: Australian Museum No. F33019.

All specimens are casts and moulds in sandy shale and often crowded on top of one another so that only part of each is visible. In the collection from Cootamundra, moulds and casts of left valves immeasurably outnumber those of right valves, which may be due to the animal resting on its left valve when alive. The shells are equivalve and inequilateral, bi-convex. The dorsal margin straight, making greatest length of shell, and extending in the holotype to a spur at post-cardinal angle, but the preservation of this angle is unusual. There is an acute sinus beneath this spur, after which posterior margin forms convex curve which continues round ventral margin to a very shallow sinus beneath small anterior ear. Body oblique, umbonal slope (about 35 degrees to vertical) continuing to posterior-ventral angle. Umbonal slope falls abruptly to anterior-dorsal angle and more gently to a sulcus which forms the border of the large triangular posterior wing which is itself very slightly arched. Anterior ear small, triangular and raised by a steep slope from the main body to a different plane. This ear, according to Spriestersbach (1909), is the most important feature of the genus. However, in the Cootamundra material it is seldom seen, and lying as it does on a different level from the rest of the shell, it must have broken easily. Umbo at anterior third, prosogyrate, blunt and broad, projecting above and over hinge-line. Ornament: Concentric, lamellar very irregular growth lines which are carried strongly on to anterior wing and a few broken radials causing crenulations such as Spriestersbach (1909) describes in his diagnosis. Ligamental area extends nearly three-quarters length of shell making an elongated triangle less than 1 mm. wide at its base on posterior margin. Longitudinal striae form a groove on a mould and ridge on a cast. Growth lines continue across it. Muscular impressions are extremely difficult to detect on the broken rough surface produced by the coarse growth lines. Teeth cannot be detected. Spriestersbach mentions the difficulty of seeing these in single valves.

*Leiopteria gregaria* closely resembles plates of *Avicula impotens* Barrande (Pl. 229, fig. I, 1) now named *Leiopteria* (*L.*) *occulta* by Ruzicka (1950) from Zone e beta of the Silurian. It is also similar to *Pterinea twenhofeli* McLearn and *P. kerfornei* Oehlert. *Tentaculites* occurs with *L. gregaria* at Cootamundra. On one specimen there are 22 casts or moulds of *L. gregaria* crowded on to a block of shale measuring 12 cm. by 4 cm. Only one of these is a right valve. Length 20 mm., height 22 mm., depth 2 mm.

*Locality*: As for *Grammysia obliqua*.

There are specimens of *Leiopteria* from Cootamundra which are considerably larger than the holotype of *L. gregaria*, being more than 30 mm. long and 35 mm. wide and 5 mm. deep, but none are sufficiently well preserved for determination as a separate species.

Genus *MYTILARCA* Hall.*Cf. MYTILARCA* sp. (Pl. xix, fig. 30.)

Cast of one left valve, broken at umbo, rhombic outline. Cardinal margin straight, sloping towards posterior angle. Anterior margin curved, ventral and posterior margins with shallow sinuses. Very prominent umbonal slope to post-ventral angle. Faintly marked concentric striae, more noticeable away from umbo. These make crenulations along cardinal margin, near post-cardinal angle. Length 10 mm., height 15 mm., depth 4 mm.

*Locality*: Barrandella shales, 6 miles south of Yass.

Genus *CYRTODONTA* Billings.*CYRTODONTA LISSA*, n. sp. (Pl. xix, fig. 29, 31, 32.)

Holotype: Australian Museum No. F48882.

Holotype is well-preserved internal cast of right valve, quadrate, inequilateral. Dorsal margin nearly straight, passing into truncate posterior margin which makes greatest height of shell. Anterior and ventral margins form smooth curve which slopes



to post-ventral angle. Very pronounced nearly angular umbonal slope with flattened cardinal furrow posterior to it. Body oblique. Tip of umbo broken in this specimen, but must have been prominent and prosogyrate; central. Surface smooth. Pear-shaped anterior adductor scar at antero-dorsal angle with vertical buttress on its posterior edge. Posterior adductor scar on cardinal slope, larger and fainter than anterior. Pallial line simple. Two curved teeth anterior to umbo on hinge plate. Posterior to umbo two teeth, thin and parallel to hinge, one of these curving around a cardinal tooth into a strong hook under umbo. Ligamental groove along dorsal margin. Length 13 mm., height 14 mm., depth 4 mm.

*Locality:* Spring Range Road, Ginninderra.

I have also placed in this species numerous undistorted internal casts of two joined valves collected by Mr. A. J. Shearsby from Forest Creek, Boambolo. They range in size up to a length of 35 mm., a height of 40 mm. and depth of 25 mm. The left valve is generally the more convex. The umbones are strongly gibbous and rise above the hinge-line, but are not quite in contact across it. While in some respects these shells agree with *Whitella* Ulrich, they have not the prominent umbo nor the well-developed escutcheon prescribed for that genus. They show faint concentric markings.

#### DYSODONTA.

Genus MODIOLOPSIS Hall.

MODIOLOPSIS ELONGATA, n. sp. (Pl. xix, fig. 11.)

Holotype: Australian Museum F27817.

Cast of left valve preserved in fine, ferruginous sandy loam. Bulbous, cylindrical, compressed anteriorly, cardinal line arched, posterior greatly expanded into convex curve. Ventral margin curves from rounded anterior-ventral angle into sinus, then steeply downward to posterior ventral angle. Broad ill-defined ridge extending to post-ventral angle. Umbo depressed, scarcely visible, nearly terminal. Faint, irregular concentric growth lines on body of shell, none on posterior ventral extension. No lunule nor escutcheon, faintly defined groove for ligament. Adductor impressions well marked, especially heart-shaped anterior; posterior larger and fainter. Pallial line simple. Length 15 mm., height 11 mm., depth 4 mm. (one valve).

The basal margin of *M. elongata* is more inclined than in ? *M. complanata* Sowerby described by Chapman (1908) or than *M. melbournensis* Chapman (1908).

*Locality:* Balheary, near Taralga.

Genus GONIOPHORA Phillips.

Subgenus COSMOGONIOPHORA McLearn.

COSMOGONIOPHORA SINUOSA Sherrard, *J. & Proc. Roy. Soc. N.S.W.*, 1952, 85, 78, Pl. VI, 7.

Holotype: Australian Museum Collection No. F44214.

Type specimen preserved in fine reddish-yellow shale. Casts and moulds in profusion at type locality. Some specimens distorted and fractured as is common in *Goniophora* (Leriche *et al.*, 1912, p. 51).

Shells equivalve, inequilateral, sub-trapezoidal. Cardinal margin straight, anterior and ventral margins form smooth curve until point where umbonal ridge projects as canal, as seen in mould. Posterior margin convex. Posterior end usually rather wider than anterior. Umbonal ridge strongly carinated, makes angle of 30 degrees with ventral margin. Umbones low, depressed and blunt, prosogyrate, situated about two-thirds distance from posterior to anterior. Post-umbonal slope depressed. Distinct circular anterior scar rather excavated, posterior scar oval, larger but fainter. Simple pallial line distinct on some casts. One cardinal tooth with spoon-shaped upper surface seen in some specimens. Well-marked concentric growth lines, 4 per millimetre, less strongly marked to the posterior of umbonal ridge. Radial striae on either side of and close to umbonal ridge. Radial striae above the umbonal ridge are characteristic of the subgenus and only seen in the Silurian (McLearn, 1924). Specimens of *C. sinuosa* are closely comparable with *Goniophora* aff. *cymbaeformis*, No. 21987, Geological Survey



of Gt. Britain, presented by Sir R. I. Murchison, with which they have been directly compared. Maximum length 21 mm., maximum height 10.5 mm., depth of each valve 0.4 mm. Greatest length about mid-width.

*Locality:* Portion 84, Par. Nanima, near Nanima Trig.; Vallance's Hill, Portion 177, Par. Nanima.

*Goniophora* sp. has been collected from the Middle Tribolite Bed, Bowning, and from the Yass Beds.

#### Genus CYPRICARDINIA Hall.

CYPRICARDINIA CONTEXTA Barrande. (Pl. xix, fig. 27.)

Cast of one small right valve, inequilateral, trapezoidal. Cardinal margin rises towards posterior, making shell wider at posterior end than at anterior. Anterior margin rounded, posterior margin rounded, rather flared. Ventral margin with very slight sinuation. Umbonal slope steep and rather angular towards both antero-ventral and post-ventral angles. Umbo very prominent at anterior third, prosogyrate, curves over nearly to cardinal edge. Lunule developed. Ornament: about 10 very prominent deeply impressed concentric ridges. Short radials connect these giving an imbricated appearance. Internal features cannot be seen. Length 9 mm., height 7 mm., depth 3 mm.

A larger, less well-preserved shell may also belong here.

*Locality:* Bowning.

#### Genus PARACYCLAS Hall.

PARACYCLAS ORBICULATA, n. sp. (Pl. xix, fig. 10.)

Holotype: Australian Museum No. F48883.

Internal cast of left valve poorly preserved in porous sandstone. Nearly circular, slightly convex, umbo central, fairly prominent, rising slightly above hinge-line. Adductor impressions large but faint. Pallial line apparently in shallow furrow. Flattened area runs along slightly arched cardinal margin. Pronounced oblique furrow along post-cardinal margin. Surface smooth. Length 14 mm., height 15 mm., depth about 3 mm.

*Locality:* Portion 177, Par. Nanima, near Morumbateman, Yass district.

De Koninck (1898) described but did not figure *Paracyclas elliptica* collected by W. B. Clarke and said to be from the Devonian of the Yass district. Dimensions are similar to *P. orbiculata*. Chapman (1909) recorded (cf.) *Paracyclas* sp. from the Silurian of Yass. Australian Museum specimen No. F27913 collected by Mitchell and labelled presumably by him, *Paracyclas*, U.T.B., Bowning, is apparently the same species. It is an external mould, 14 mm. long, 12 mm. high. It shows regular concentric ridges 1 mm. apart, for 6 mm. within the ventral margin. *P. orbiculata* is similar in size and description to *P. fletcheri* from Gaspe, Canada (Northrop, 1939).

#### SUMMARY.

Thirty-one Silurian lamellibranchs are described, including twenty new species. The relation of beds in which the lamellibranchs occur to beds known to contain graptolites is given where possible. By this means an exact age can be stated for the lamellibranch-bearing strata in some cases. A summary of previous references to Silurian lamellibranchs in New South Wales is included. Correlations with Silurian lamellibranchs from other countries are suggested.

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## EXPLANATION OF PLATE.

Nos. 1-13, 31, 32 approximately natural size; Nos. 14-30 approximately  $\times 2$ .

1. *Grammysia ampla*, n. sp., Bowning, A.M. No. F48878.
2. *Grammysioidea declivis*, n. sp., Upper Trilobite Bed, Bowning, A.M. No. F27876.
3. *Grammysia compressa*, n. sp., Yass Beds, Sydney University Geological Department Collection No. 8572.
4. *Palaeosolen planus*, n. sp., Cootamundra, A.M. No. F32976.
5. *Panenka cingulata* Chapman, Cootamundra, A.M. No. F31882.
6. *Lunulicardium quedongensis*, n. sp. (posterior view), Quedong, near Bombala, A.M. No. F23306.
7. *Tancrediopsis victoriae* (Chapman), Yass Beds, Syd. Univ. Geol. Dep., No. 8573.
8. *Pteronitella rugosa*, n. sp., Hatton's Corner, Yass, A.M. No. F48881.
9. *Actinopterella lamellosa*, n. sp., Bowning, A.M. No. F2750.
10. *Paracyclas orbiculata*, n. sp., Morumbateman, near Yass, A.M. No. F48883.
11. *Modiolopsis elongata*, n. sp., Balheary, near Taralga, A.M. No. 27817.
12. *Grammysia obliqua*, n. sp., Cootamundra, A.M. No. 32975.
13. *Cardiola* (Slava) *fibrosa* Sow., Hatton's Corner, Yass, A.M. No. F48879.
14. *Paracardium* cf. *filosum* Chapman, Bowning, A.M. No. F49131.
15. *Grammysioidea declivis*, n. sp., Bowning, A.M. No. F27901.
16. *Tancrediopsis minuta*, n. sp., Bowning, A.M. No. F29429.
17. *Nuculites pseudodeltoides* Reed, Bowning, A.M. No. F29431.
18. *Tellinopsis flabelliformis*, n. sp., Bowning, A.M. No. F29393.
19. *Nuculites scissa*, n. sp., Upper Beds, Bowning, A.M. No. F27897.
20. *Tancrediopsis delicatula*, n. sp., Bowning, A.M. No. F27931.
21. *Nuculopsis triangula*, n. sp., Bowning, A.M. No. F29410.
22. *Nuculana striata*, n. sp., Cootamundra, A.M. No. F32995.
23. *Actinopterella minuta*, n. sp., Hatton's Corner, Yass, A.M. No. F48880.
24. *Leiopteria gregaria*, n. sp., Cootamundra, A.M. No. F33019.
25. *Rhombopteria laminosa* (De Koninck), Yass Beds, Yass, Syd. Univ. Geol. Dep. No. 8570.
26. *Rhombopteria obliqua*, n. sp., Cootamundra, A.M. No. F32985.
27. *Cypricardinia contexta* Barrande, Bowning, A.M. No. F29435.
28. *Actinopterella formosa*, n. sp., Yass Beds, Yass, Syd. Univ. Geol. Dep. No. 8571.
29. *Cyrtodonta lissa*, n. sp., Ginninderra, A.M. No. F48882.
30. Cf. *Mytilarca* sp., Barrandella Shales, 6 miles south of Yass.
31. *Cyrtodonta lissa*, n. sp., Forest Creek, Boambolo, A.M. No. F49138 (posterior view).
32. *Cyrtodonta lissa*, n. sp., Forest Creek, Boambolo, A.M. No. F49138. Left valve.





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