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NEW LAMELLIBRANCHIA FROM THE UPPER PERMIAN OF WESTERN AUSTRALIA.

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(Plates xxxiv–xxxv.)

Introduction.

In this paper two new genera of lamellibranchia are recognized from the Upper Permian beds of Western Australia. Four species are described from the Wandagee Series, while two are also recorded from the Nooncanbah Series, its northern equivalent in the West Kimberley Division.

The shells are of particular interest as they possess a wide V or chevron-shaped type of ornamentation which is rarely found on palaeozoic shells. They are edentulous, posteriorly-gaping forms, possessing close affinities with mesozoic shells of the Family Pholadomyidae. The two new genera bear a close resemblance to Permian shells recently described from Madagascar by Astre (1934) and also have many points in common with Jurassic shells from the Spiti Shales described by Holdhaus (1913) as *Goniomya* Agassiz and *Cosmomya*, gen. nov.

The specimens with two exceptions were collected by Dr. Curt Teichert, late of the University of Western Australia, at whose request the following paper has been prepared. The material is fairly well preserved but the specimens are in varying stages of incompleteness. The hardness of the matrix in which the shells are preserved prevented any development of internal structures, and the descriptions and conclusions have therefore been based entirely on external characters.

A series of fifteen specimens were collected from the Wandagee Series of the Minilya River district in the North-West Basin. A single specimen (F.38415) was collected by Mr. H. Coley from the same locality, while an incomplete specimen (F.16746) was collected by Dr. H. Basedow in 1914 from Mount Marmion, near Balmaningarra in the West Kimberley Division. The two numbered specimens are in the collection of the Australian Museum, while the remainder are in the collection of the University of Western Australia.

Stratigraphical Position of the Species.

The Wandagee Series immediately underlies the Kennedy Sandstone, which has been placed at the top of the Permian sequence in that area by Teichert (1941, p. 381). Because of the extremely fossiliferous nature of the Wandagee Series, Teichert was able to subdivide it into four stages, each one characterized by a distinct fossil fauna. The stratigraphical positions of the species described in this paper are as follows: In descending order—

Kennedy Sandstone	200 +	feet
Wandagee Series	2,600	„
Linoproductus Stage	1,090	„
Highest fossil horizon.		
Undulomya pleiopleura, sp. nov.		
Lowest fossil horizon.		
Undulomya pleiopleura, sp. nov.		
Palaeocosmomya teicherti, sp. nov.		
Schizodus Stage	340	„
Calceolispongia Stage	560	„
Undulomya rugulata, sp. nov.		
Palaeocosmomya teicherti, sp. nov.		
Lingula Stage	590	„
Palaeocosmomya teicherti, sp. nov.		
P. aplatum, sp. nov.		

The specimen of *Undulomya rugulata* from the West Kimberley Division was collected from the top beds of the Nooncanbah Series at Mount Marmion, near Balmaningarra. Teichert (1941, p. 389) suggested a correlation between the Wandagee and Nooncanbah Series, so that the occurrence of *Undulomya rugulata* in both horizons is additional evidence in favour of this correlation.

Discussion of Genera.

The two new genera from Western Australia bear a close resemblance to Jurassic bivalves and there seems to be little doubt that it is to Mesozoic forms such as *Goniomya*, *Pholadomya* and *Cosmomya* that we must look for close comparisons. Holdhaus (1913, p. 450) described and figured *Goniomya uhligi* and (1913, p. 446) *Cosmomya egregia* from a Jurassic fauna of the Spiti Shales. These species, based on incomplete specimens, possess a striking resemblance to the Australian genera *Undulomya* and *Palaeocosmomya* respectively. The genus *Cosmomya* is unknown outside the Spiti Shales, but *Goniomya* is a well-known genus with a wide distribution.

It has usually been accepted that the genus *Goniomya* did not occur in strata older than the Jurassic, although, as far back as 1885, Krotov (1885) recorded a shell from the Artinskian of Russia as *Goniomya artiensis*, while Geinitz (1880, p. 38) described a species with the typical ornamentation of *Goniomya* as *Pholadomya kasanensis*.

These two species were accepted by Netschajeff (1894) as belonging to the genus *Goniomya*, presumably more on the evidence of the V-shaped ornamentation than other characters. He pointed out features of difference from the typical mesozoic species of *Goniomya* in the position of the umbones, the degree of inequilaterality and the broadness of the posterior margin. Diener (1903, p. 176) agreed with Netschajeff that these differences were insufficient to remove the Russian species from the genus *Goniomya*, as he pointed out that there is a great deal of variation in its species. Diener thought, however, that the generic determination of the two Russian species was not entirely free from objection. At the same time he recorded and figured an incomplete shell from the Kuling Shales of Kuling in Spiti (Permian) as *Goniomya* sp. indet. aff. *G. kasanensis* Geinitz. Diener (1903, p. 126) also described a further incomplete shell as *Goniomya* sp. indet. from the Productus Shales at Kalapani in Byans (Permian). In recording this species Diener states that "it seems rather hazardous to quote this genus in a permian fauna . . . it would however, be very difficult to decide in which genus the shell here under consideration ought to be placed, as in all its external characters it resembles so closely a Jurassic *Goniomya*".

Within recent years other references in literature have appeared regarding the occurrence of *Goniomya* in rocks of Permian age. Dighton Thomas (1928, pp. 224–229) described and figured three species of shells with a type of V-shaped ornamentation from a fauna recorded as "Upper Carboniferous from the Omatpe Mountains of North-Western Peru". The shells were referred to the genus *Sanguinolites* in preference to *Goniomya*. Thomas states that interruption of the ribbing is not at all a common feature of the lamellibranchia, though it is a typical character of *Goniomya*. He compared one species, *S. inordinatus*, with *S. v-scriptus* of Hind (1900, p. 382), stating that it is quite different from the Permian *Goniomya* of Russia and the Himalayas. Thomas refers his other two species, *S. insolitus* and *S. deportatus*, to the genus *Sanguinolites* as they appear to belong to that genus, although, as he states, the ornamentation is not normal for it.

From the Permian beds of Madagascar, Astre (1934, p. 82) has described two species of shells with typical V-shaped ornamentation as *Goniomya* sp. aff. *kasanensis* Geinitz and a new species *G. disangula*. These two species in my opinion are very similar to the shells from Western Australia and should be included in the two genera described in this paper as *Undulomya* and *Palaeocosmomya* respectively.

In a recent paper Vangerow (1937) lists the Mesozoic species of *Goniomya* and includes Diener's Himalayan forms in one of the Jurassic species. He mentions, however, that the Permian species may belong to another genus but gives no reasons.

Shells with a characteristic V-shaped ornamentation, usually considered to be typical of the genus *Goniomya*, have therefore been found and recorded from upper palaeozoic rocks in Russia, Peru, Madagascar, Australia, and the Central Himalayas. With the exception of the shells from Peru, authors have referred them to the genus *Goniomya*, but usually with some degree of doubt or hesitancy. Before it can be accepted that the vertical range of *Goniomya* must be considerably extended to embrace a number of Permian species, it is necessary to establish exactly the generic characters of that genus. The interrupted type of ribbing, or V-shaped ornamentation, has been stressed as an important character of *Goniomya*. It is a form of sculpture not usually found in the lamellibranchia, but it certainly cannot be considered as a distinctive generic character.

The genus *Goniomya* was instituted by Agassiz (1842, p. 1) to include Jurassic shells with a characteristic type of V-shaped ornamentation and gaping extremities.

A great deal of variation is apparent in the thirty-three species which Agassiz referred to his genus *Goniomya*. The shell characters show such diversity of form that Agassiz was able to subdivide the genus into groups which he referred to as Ovale, Tronquées, Cylindracées and Trapèzoides. For a restricted diagnosis of the generic characters of *Goniomya* it is necessary to refer to the type species of the genus. Agassiz did not designate a genotype, so the type of the genus automatically becomes *Goniomya sulcata*, the first species described. It is a distinctive form belonging to the Cylindracées group and is well figured by Agassiz (1842, Pl. 1, figs. 8–9; Pl. 1*b*, figs. 9–12; Pl. 1*c*, figs. 13–14). The specimens appearing first in the illustrations (Pl. 1*b*, figs. 9–12) are excellent reproductions and are the nearest in appearance to the Australian Permian shells.

The description of *G. sulcata* is briefly as follows:

General form of the shell elongate and cylindrical; anterior margin short, truncated, and not the depth of the shell. Slightly gaping anteriorly. Posterior portion of shell strongly developed and not attenuated at the posterior margin, rather with a tendency to broaden and widely gaping; obliquely truncate.

Ribs strong, rounded and V-shaped, separated by moderately large intervals. Anterior ribs deeper and more pronounced, less numerous than posteriorly, directed obliquely behind so that the last run more or less parallel with the top edge. Ribs over-run with fine striations. Beaks little elevated and contiguous. A long and well-marked escutcheon, deep near the umbones, shallowing posteriorly, is present. A lunule is also developed.

Conclusions.

The Western Australian shells described in this paper as *Undulomya* appear to have some affinities with the Jurassic genus *Goniomya* (*sensu lato*). They are very similar to, if not identical with, the shell described from Madagascar as *Goniomya* sp. aff. *kasanensis* Geinitz, and therefore possess relationships with similar Permian shells from the Himalayas and Russia. Their relationships with the Peruvian species are more obscure, although *Sanguinolites insolitus* of Thomas has a number of characters in common with the Australian forms of *Undulomya*.

There are a number of important features found in the Permian genus *Undulomya* which clearly distinguish it from the mesozoic genus *Goniomya*, and these are discussed later in this paper. The long geological break between these two genera is also an important factor and at least indicates a likely dissimilarity in morphological structures. It was found necessary, therefore, to institute a new genus for the Western Australian shells after the form of *Goniomya*, as they could not be satisfactorily placed in that genus.

The relationships of the new genus *Palaeocosmomya* and its points of difference from the Jurassic genus *Cosmomya* of Holdhaus are detailed later in this paper.

Systematic Descriptions.

Phylum MOLLUSCA.
Class LAMELLIBRANCHIATA.
Order *Anomalodesmacea.*
Superfamily *Pandoracea.*
Family *Pholadomyidae.*

Genus **Undulomya** gen. nov.*

Genotype: *Undulomya pleiopleura* sp. nov.

Generic Characters.—Shell elongate, equivalve, very inequilateral, moderately convex becoming compressed posteriorly and inferiorly. Anterior portion very short and vertically narrowed; margin rounded inferiorly. Posterior portion produced, with a bluntly-pointed posterior margin. Umbones situated anteriorly, close to anterior margin, depressed, not prominent, directed and sloping anteriorly. Escutcheon long and triangular, flattened, extending to the posterior margin; an oblique posterior-directed ridge separates it into two unornamented areas. Lunule small. Shell gaping posteriorly, no anterior gape. Edentulous.

Interior musculature characters unknown.

Ornamentation consists of anterior V-shaped ribs with heavy curved ribs and wide interspaces posteriorly. Line of inflection of V-shaped ribs extends backwards and downwards at approximately an angle of 35°. A narrow inferior margin on which ribs do not extend, tapering and finally disappearing half-way along the shell. Valves covered with fine concentric lines of growth.

Shells approximately 80 to 90 mm. in length and from 40 to 45 mm. in height.

Observations.—Nine specimens in varying degrees of completeness are referred to this genus and represent two distinct species. Its nearest relationships are with the mesozoic genus *Goniomya* and with almost identical Permian shells from Madagascar and the Himalayas which have been referred by authors to that genus. The genus *Undulomya* differs from *Goniomya* in the following features: The general outline and appearance are dissimilar in that the posterior extremity becomes somewhat attenuated by a persistent curving of the inferior margin and consequent decrease in depth. The umbones are very depressed, directed anteriorly and situated near the anterior extremity. The position of the depressed umbones on the anterior slopes gives the shell a rather characteristic twisted or leaning appearance in that direction.

A well-developed escutcheon is present in the genus *Undulomya.* It is bordered superiorly by a straight hinge-line and inferiorly by a definite ridge or fold. Between this fold and the ornamented, convex part of the valve is a distinct elongated groove which is free from ribbing. A distinct lunule is absent.

These rather characteristic features, together with the fact that there is no anterior gape and the posterior gape of the shells is not nearly as pronounced as in the genus *Goniomya,* are of sufficient generic importance to justify the erection of a new palaeozoic genus. Furthermore, the ribbing on shells of *Undulomya* appears to be of a heavier type and far more pronounced than is found in the genus *Goniomya,* although the ornamentation follows the same pattern.

The shell described by Astre (1934, p. 82, Pl. x, figs. 12–14) as *Goniomya* sp. aff. *kasanensis* Geinitz, in my opinion, must be included in the genus *Undulomya.* It is very similar in every respect, and the specimen (1934, Pl. x, fig. 14) shows clearly the escutcheon, the oblique ridge, and the twisted appearance of the valves. The line of inflection of the V-shaped ribs passes backwards and downwards at the same angle as in specimens of *Undulomya.* The specimen figured by Diener (1903, Pl. viii, fig. 11) as *Goniomya* sp. ind. (aff. "*kasanensis*" Geinitz) differs from the Western Australian and Madagascan shells in that the line of inflection of the V-shaped ribs is vertical and the umbo is not twisted and directed anteriorly. On the other hand there is a slight indication of the escutcheon which is so well developed in the genus *Undulomya.* Owing

* Ety.: *unda,* a wave, from the wavy appearance of the valves; *Mya,* a genus of shells.

to the fragmentary nature of the Himalayan shells it was impossible to give any dimensions, but as far as the Madagascan shell is concerned, its size agrees well with *Undulomya pleiopleura* from Western Australia.

It is possible that the shells from north-west Peru, mentioned earlier in this paper, may have some relationships with the genus *Undulomya*. Three species with characteristic ornamentation were described by Dighton Thomas (1928, pp. 224–229), and of these, *Sanguinolites insolitus* has many features in common with the Australian Permian genus.

The known geological range of the genus *Undulomya* in the Western Australian Permian deposits is the Wandagee Stage of the North-West Basin and its northern equivalent, the Nooncanbah Stage of the West Kimberley Division.

Undulomya pleiopleura sp. nov.

(Plate xxxiv, figs. 1–5; plate xxxv, fig. 1.)

Holotype: WF10.1 (A). *Paratypes*: WF10.1 (B); T5 (A). Collection of the University of Western Australia.

Specific Characters.—Shell equivalve, very inequilateral, elongated becoming somewhat attenuated posteriorly. Moderately convex with maximum inflation in the dorsal mid-line, declining rapidly anteriorly and inferiorly but gradually posteriorly. Anterior portion about one-sixth the entire length of shell; its margin straight to concave above, bluntly rounded and projecting below. Ventral margin long, slightly curved anteriorly, then almost straight until near the posterior extremity it rapidly curves upwards to meet the rather truncated posterior margin of the flattened dorsal area. Hinge-line straight, inclining posteriorly.

The umbones are low, depressed, inclined and directed anteriorly, giving the valve a somewhat leaning and twisted appearance in that direction. The points of the umbones are contiguous, recurved slightly and overhanging the hinge-line. A pseudo-lunule is present. The escutcheon is long and narrow, extending from below the umbo to the posterior border, and gradually widening. It is bordered superiorly by the straight hinge-line and inferiorly by a prominent fold or ridge originating below the umbo and extending obliquely backwards to the posterior margin. It is separated from the swollen and ornamented valve flanks by a well-defined groove which increases in width posteriorly. The escutcheon and groove are flat or slightly concave and unornamented, with the exception of very fine, curved growth striae which cross from the hinge-line on to the ornamented part of the valve. The median ridge or fold is ornamented with short ridges, their line of direction being opposite to that of the valve ribbing, except on the posterior half, where it is the same. (See Pl. xxxiv, fig. 2.) A well-pronounced ligamental area, of which only a portion is preserved on one specimen, indicates a well-developed external ligament of an amphidetic type.

The ornamentation consists of prominent rounded ribs, V-shaped anteriorly, curved posteriorly, and gradually increasing in size until, on the posterior third of the valve, they are large with wide interspaces. The larger and curved ribs are independent and do not form an arm of the anteriorly-placed chevrons.

The line of inflection of the V-shaped ribs originates at the apex of the umbo and extends backwards and downwards at an angle of about 45° but does not reach the inferior border. Around this border is a narrow margin, tapering posteriorly, ornamented with crowded, fine striae and on which the main valve ribbing does not extend. (See Pl. xxxiv, figs. 5–6.)

The ribs anterior to the line of inflection are eleven in number, crowded near the umbo and becoming stronger, with wide and deep interspaces towards the ventral margin. They originate from below the umbo and are more or less concentric, following the course of the growth striae.

The ribs posterior of the line of inflection extend obliquely upwards and backwards and, when crossing the post-umbonal swelling, curve sharply forwards and terminate

on the edge of the elongated groove or furrow. Traces of the ribbing are then visible on the ridge bordering the escutcheon, but directed sharply backwards, and are more in the form of nodules. These ribs, forming the posterior arms of the V-shaped ornamentation, are about fourteen in number. The remaining independent posterior ribs are about ten in number, originating from the ventral border and passing well backward before curving upward over the valve and adopting a greater curvature on the swelling of the valve near the superior margin. Traces of these ribs appear on the post-umbonal ridge and follow the course of the ribs, the exact opposite to what is found on the ridge near the umbo.

Although not well preserved, there are indications that the valve was covered with numerous, fine and closely arranged concentric striae of growth.

Internal structures are not visible on any specimens, but there is no doubt the shells are edentulous.

The dimensions of three specimens are as follows:

	Holotype. WF10.1 (A).	Holotype. WF5.12 (A).	Paratype. T5 (A).
Length	98 mm.	74 mm.*	62 mm.*
Height	38 mm.	34 mm.	34 mm.
Width	30 mm.	28 mm.	28 mm.

Observations.—The species of the genus *Undulomya* are quite unlike any other lamellibranchs found in the Permian rocks of Australia. As pointed out earlier in this paper, the shell from Madagascar, described as *Goniomya* sp. aff. *kasanensis* by Astre, is very similar and must be included in the genus *Undulomya*. It appears to have fewer ribs, but other points of similarity are most striking. The dimensions, as far as can be determined from the measurements of the incomplete specimens, agree very well with those of the Australian shells.

Sanguinolites insolitus described by Dighton Thomas from north-west Peru, although a much smaller shell, has some important characters in common with *Undulomya pleiopleura*. The already-mentioned Himalayan species differs from this species in the umbones being erect and in the vertical line of inflection of the anterior V-shaped ribbing.

The specimen figured on Plate xxxiv, figures 3–4, differs slightly from the typical specimens in that the ribs are more pronounced with deeply-excavated interspaces.

Localities and Geological Horizons.—Western Australia: Uppermost beds in centre of syncline, one mile west of Coolkilya Pool, north bank of Minilya River, Wandagee Station, North-West Basin. Holotype and paratype locality; west limb of syncline, Coolkilya Flat, north of Wandagee Hill, Wandagee Station. (Lowest fossil horizon, Linoproductus Stage, Wandagee Series.) Three hundred yards east of south-eastern gully of Wandagee Hill, Mungadan Paddock, Wandagee Station. (Highest horizon, Linoproductus Stage, Wandagee Series.)

Undulomya rugulata sp. nov.

(Plate xxxiv, fig. 6; plate xxxv, figs. 2–3.)

Holotype: WC(27–32)1 (A), collection of University of Western Australia.

Specific Characters.—Shell equivalve, very inequilateral, convex, maximum inflation in the mid-line and nearer the posterior than the anterior extremity. Anterior portion of shell short with rounded margin. Ventral margin sloping from anterior and posterior margins so that the greatest height of the shell is in the central position. Umbones depressed, situated low on the anterior slope, directed anteriorly and slightly twisted; apices contiguous and overhanging the hinge-line.

Ornamentation consists of about fifteen sharply keeled, concentric, anterior ribs, and about twenty-seven upwardly directed, rounded, posterior ribs. These are crowded on the umbonal region but become widely spaced towards the inferior and the posterior

* Incomplete. Measurement given is actual length of incomplete shell.

margins. From the apex of the umbo there extends backwards and downwards at an angle of approximately 45° a distinct groove which does not quite reach the ventral margin. At this groove the concentric ribs bend sharply upwards and posteriorly with only a slight curve, until, when crossing the dorsal slope and nearing their extremities, they bend sharply forwards. The most inferiorly placed concentric rib does not bend upwards but continues around the shell as a distinct concentric rib. Below this rib the valve surface is smooth and unornamented, with the exception of well-defined and crowded concentric lines of growth. Approximately twelve of the most posteriorly placed ribs do not junction with the anterior concentric ribs and thus do not form the wide V-shaped ornamentation found on the anterior half of the valve. They follow the same general course, but their lower extremities end slightly above the main concentric rib. The upwardly-directed posterior ribs are rounded with wide interspaces and are not nearly as sharp or keeled as the anterior concentric ribs.

The surface of the valves is covered with numerous fine striae of growth.

Internal characters not exhibited.

The dimensions of the holotype are:

Length	73 mm.[1]	85 mm.[2]
Height	40 mm.	42 mm.
Width	30 mm.	30 mm.

Observations.—This unmistakable species is represented by two incomplete specimens from two localities. The holotype is in a fairly good state of preservation, but unfortunately the whole of the superior flattened portion including the escutcheon and the posterior extremity is missing. It differs markedly from *Undulomya pleiopleura* in that the independent posterior ribs, those not forming the V-shaped ornamentation, are far more vertical and do not assume the great width of the posterior ribbing in *U. pleiopleura.* The height in relation to length is greater in this species; as in the former species the shell is very strongly produced posteriorly.

Localities and Geological Horizons.—East limb of syncline, north bank of Minilya River, Wandagee Station, North-West Basin. Holotype locality. (Lower 100 feet in the Calceolispongia Stage, Wandagee Series.) Mount Marmion, near Balmaningarra, West Kimberley Division. (Nooncanbah Stage.)

Genus **Palaeocosmomya** gen. nov.*

Genotype: *Palaeocosmomya teicherti* sp. nov.

Generic Characters.—Shells equivalve, inequilateral, about one and a half times as long as high, moderately inflated, widely gaping posteriorly. Anterior margin rounded, merging evenly into a downwardly inclined and but slightly curved ventral margin; posterior margin rounded, projecting inferiorly. Hinge-line short, straight, depressed. Lunule small, escutcheon distinct and widely triangular. Ligamental area or depression beneath and posterior to umbones.

Umbones conspicuous, inflated, apices twisted anteriorly. A narrow, well-defined groove traverses the valve from the apex of the umbo to the ventral margin with a slight forward incline.

Ornamentation consists of concentric ribs on the anterior half of the valve and an almost vertically arranged line of V-shaped ribs with short anterior and elongated posterior arms on the posterior half of the shell. The umbonal groove traverses the concentric ribs and is not a line of inflection.

The shells range to a length of 45 mm. and a height of 30 mm.

Observations.—A series of six incomplete specimens has been referred to this genus and includes two species. These shells possess many characters which link them with the Jurassic genus *Cosmomya* of Holdhaus (1913, p. 46). This genus was described

[1] Actual incomplete dimensions.

[2] Approximate complete dimensions.

* Ety.: *palaios*, ancient; *Cosmomya*, a genus of shells.

from a single cast of a left valve which unfortunately is an incomplete specimen with no complete margins. The Australian Permian shells possess a variation in the pattern of the ornamentation but in most of the other exhibited characters appear to be very similar. It is most improbable that shells with such a highly specialized type of ornamentation would persist through a long geological range, and I am confident that when complete shells of *Cosmomya* can be compared with the Australian Permian shells there will be little difficulty in determining them as being distinct forms.

I can find very few points of dissimilarity between *Goniomya disangula* of Astre (1934, p. 83) and *Palaeocosmomya teicherti* sp. nov. The specimens are remarkably alike and there is little doubt that his species must be referred to the Australian genus *Palaeocosmomya.* Holdhaus (1913, p. 46) indicates a relationship of *Cosmomya* with *Ceromya* because of the general shape, position of the umbones and their inwardly curved nature, and the ornamentation. Astre saw a relationship with certain "*Anatina*" of the Secondary because of the umbo possessing a transverse groove or fissure, but apart from this feature they have little in common. In *Palaeocosmomya* the sloping sides of the cardinal area indicate a well-developed parivincular type of ligament. It is impossible, however, to come to any definite conclusions from the incomplete material in which internal structures are entirely lacking, and so for the time being the genus is placed in the Family Pholadomyidae.

The genus *Palaeocosmomya* is so far known only from the Wandagee Series of the North-West Basin.

Palaeocosmomya teicherti sp. nov.
(Plate xxxiv, figs. 7–8; plate xxxv, figs. 4–6.)

Holotype: WC(27–32)1A, Paratype T171A, collection of University of Western Australia.

Specific Characters.—Shell equivalve, inequilateral, sub-ovate, evenly convex, one and a half times as long as high. Anterior margin rounded, merging with a downwardly inclined but slightly convex ventral margin. Posterior margin rounded with a tendency for the shell to thicken, in the form of a lip along the border. Hinge-line straight, short and depressed below superior border. Posterior extremity of shell widely gaping.

Umbones conspicuous, elevated, apices overhanging hinge-line, contiguous and recurved slightly anteriorly; situated slightly anterior of a vertical median line. A narrow well-defined groove, originating at the apex of the umbo, passes down the valve to the ventral margin with a slight forward inclination.

The ornamentation consists of comparatively heavy, more or less concentrically arranged ribs on the anterior half of the valve which become V-shaped posteriorly. The anterior ribs are about 18 to 20 in number and become more widely separated as they approach the inferior margin. They originate at the anterior margin and pass more or less concentrically backwards, but with an upward tendency, to a line of inflection which is vertical between the centre of the umbo and the inferior margin. Shortly after crossing the anteriorly inclined narrow groove, where the upward tendency of the ribs is more pronounced, they bend abruptly downwards at an angle of about 45° to a main line of inflection forming the base of the Vs. This line extends from the point of the umbo to the inferior margin at an angle of about 30°. At this line of inflection the ribs bend sharply upwards and backwards to a well-defined ridge separating the ornamented convex portion of the shell from the escutcheon.

Lunule short and broad. Escutcheon well defined, broadly triangular, extending to the posterior margin. It is bordered inferiorly by a distinct ridge or fold which originates from behind the apex of the umbo and passes backwards and downwards to meet the posterior margin at a little above its central position. Superiorly it is bordered by a short, straight hinge-line for half the distance, the margin then rising slightly and curving outwards and downwards to form the beginning of the gape and the upper part of the posterior margin. The actual posterior border is bent outwards to form a definite lip. The surface of the escutcheon is convex and is unornamented.

Also originating from behind the umbo is a narrow ridge which very soon merges into the convex surface of the escutcheon (see Pl. xxxv, fig. 5). Between it and the depressed hinge-line is a narrow, elongated, downwardly-sloping area, deep in the umbonal region and gradually flattening posteriorly to disappear at the same time as the small median ridge. This area was for the reception of the ligament. It is not continued forward of the umbo and would appear to be of the parivincular type.

The dimensions of several specimens are as follows:

	WC(27–32)1B (Holotype).	T.171A (Paratype).
Length	33 mm.*	33 mm.
Height	27 mm.	23 mm.*
Width (both valves) ..	20 mm.	20 mm.

Observations.—Five specimens have been referred to this species and of them two only are in any way complete. The holotype consists of both valves with only the ventral margin missing, but the ornamentation is not well preserved. The specimen selected as paratype is a left valve which has the sculpturing well preserved but with all the margins missing with the exception of a small portion of the hinge-line.

The shells of this species are outstanding on account of the characteristic ornamentation, the broad unornamented escutcheon and the widely-gaping posterior margins with thickened edges. The ornamentation agrees with a species described by Astre (1934, p. 83) from Madagascar, but other characters of the shell agree more perfectly with *Palaeocosmomya aplatum*, another Western Australian species described in this paper.

The present species bears a remarkable resemblance to a Jurassic form described by Holdhaus (1913, p. 446) from the Spiti Shales but differing in that the V-shaped ribbing on the posterior half of the valve is not well defined in comparison with the Australian shells. The escutcheon is also not as well developed or as broad posteriorly. It is unfortunate that the material is incomplete, otherwise more definite conclusions could be made.

Localities and Geological Horizons.—East limb of syncline one mile west of Coolkilya Pool, north bank of Minilya River, Wandagee Station. (Holotype locality); near mouth of north-western gully of Wandagee Hill, Wandagee Station. (Paratype locality). (Linoproductus Stage, Wandagee Series.) On road from Wandagee Homestead to Garden outcamp, Wandagee Station (Lingula Stage, Wandagee Series).

Palaeocosmomya aplatum sp. nov.
(Plate xxxv, figs. 7, 8.)

Monotype: WL1(A). Collection of University of Western Australia.

Specific Characters.—Shell equivalve, inequilateral, moderately inflated anteriorly, compressed posteriorly. Anterior margin projecting with little depth, rounded inferiorly; anterior half of the ventral margin straight, inclining downwards and becoming curved posteriorly to form a rounded and projecting postero-ventral margin. The posterior margin is slightly concave superiorly. Postero-dorsal margin rounded, passing forward and inward to join the short, straight hinge-line. Shell gaping fairly widely with a dorsal maximum width.

Umbones prominent, elevated, much higher than the hinge-line, situated anteriorly. Escutcheon broadly triangular. Ligamental area posterior to the umbones, deep near them but shallowing posteriorly and disappearing before the end of the hinge-line. A narrow, well-defined groove extends from the apex of the umbo to the ventral margin; on the umbonal slope it is vertical but gradually inclines forwards for the lower half of its length.

Ornamentation consists of fairly heavy sub-concentric anterior ribs and finer V-shaped ribs on the posterior half of the valves. The anterior ribs originate at the anterior margin with a slight downward slope before bending upwards at a slight angle

* Incomplete. Actual incomplete dimensions.

and passing round the valve to a line of inflection slightly posterior to the umbonal groove. At this point the ribs lose some of their thickness and bend abruptly downwards to a second line of inflection which forms the bases of the V-shaped ribs. The ribs then pass sharply backwards and upwards to the edge of the broad escutcheon. The extreme compressed posterior portion of the shell does not possess ribbing.

The dimensions of the monotype are as follows:

Length	46 mm.
Height	25 mm.*
Width (both valves)	17 mm.
Hinge-line	24 mm.

Observations.—This species differs from *Palaeocosmomya teicherti* in being strongly compressed posteriorly and inferiorly and as a result the posterior gape is not as wide. The umbones are also situated more anteriorly. The single specimem belonging to this species has the umbones broken off while a small portion of the ventral margin is also missing. This shell is very similar to the species described and figured by Astre (1934, p. 83, Pl. x, figs. 15, 17) but differs in being more compressed. The umbones are more elevated in the Australian shell and the height in relation to length is greater.

Locality and Geological Horizon.—East limb of syncline, north bank of Minilya River, near Coolkilya Pool, Wandagee Station. (Lingula Stage, Wandagee Series.)

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EXPLANATION OF PLATES XXXIV-XXXV.

Plate xxxiv.

Undulomya pleiopleura sp. nov.

Fig. 1.—Left valve showing broad posterior ribs and oblique post-umbonal ridge. Anterior portion with ribs and line of inflection and part of ventral margin missing. No. WF10.1.

Fig. 2.—Incomplete left valve exhibiting ornamentation on the oblique post-umbonal ridge. No. WF10.1B. (Paratype.)

Fig. 3.—Right valve with exceptionally heavy posterior ribbing. No. T5 (A). (Paratype.)

Fig. 4.—Left valve with well-defined ribbing and line of inflection. Flattened dorsal area and posterior extremity of shell are missing. No. T5 (A).

Fig. 5.—Impression of portion of the ornamentation at the line of inflection and also showing the ventral margin area on which the V-shaped ribs do not extend. No. WF10.4.

Undulomya rugulata sp. nov.

Fig. 6.—Portion of right valve with finely keeled anterior ribs, line of inflection and rounded posterior ribs. Also exhibited is the single concentric rib which traverses the smooth ventral marginal area. No. F 16746.

Palaeocosmomya teicherti sp. nov.

Fig. 7.—Left valve of holotype with ventral margin missing. Dorso-ventral umbonal groove is exhibited. No. WC(27-32)1A.

Fig. 8.—Dorsal view of the holotype showing short hinge-line and extent of posterior gape.

Plate xxxv.

Undulomya pleiopleura sp. nov.

Fig. 1.—Right valve of the holotype, complete ornamentation and upward curve of the ventral margin nearing the posterior extremity. No. WF10.1A.

* Height incomplete. Actual measurement of shell.

Undulomya rugulata sp. nov.

Fig. 2.—Left valve of holotype, posterior extremity missing, exhibiting ornamentation and smooth ventral marginal area with single concentric rib. No. WC(27-32)1A.

Fig. 3.—Anterior view of the holotype.

Palaeocosmomya teicherti sp. nov.

Fig. 4.—Left valve of paratype with the broadly triangular escutcheon not preserved. No. T171.

Fig. 5.—Incomplete right valve of an immature shell showing the dorsal area.

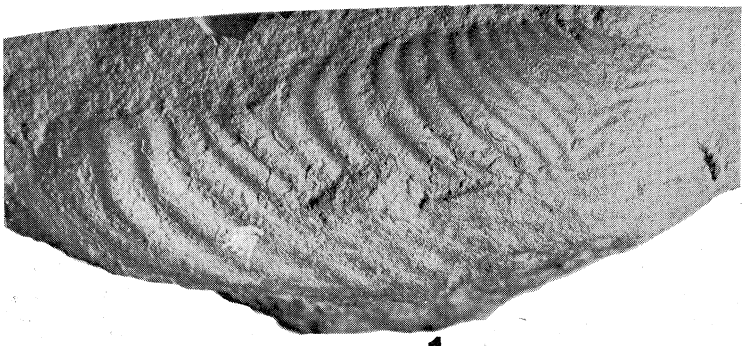
Fig. 6.—Right valve of the holotype with complete posterior margin. The ventral margin and ornamentation are not preserved.

Palaeocosmomya aplatum sp. nov.

Fig. 7.—Right valve of the monotype. The umbones and a small portion of the ventral margin, posterior of the mid-line, are missing. No. WL1.

Fig. 8.—Dorsal view of the monotype showing compressed posterior portion of the shell. The curvature of the posterior margin, forming the gape, is shown by the left valve.

G. C. Clutton, photo.



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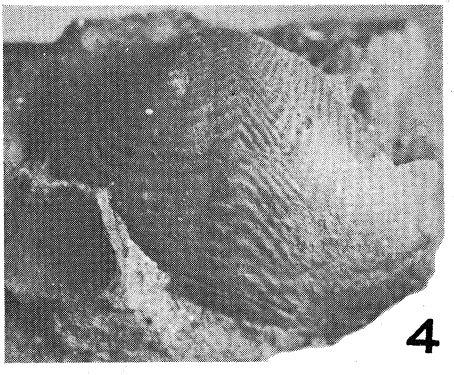

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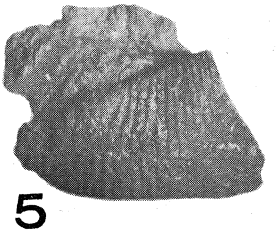

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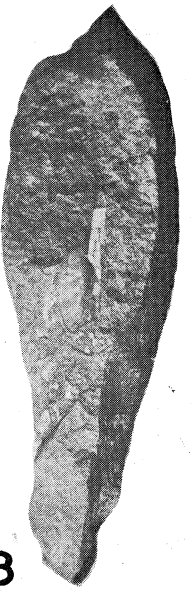

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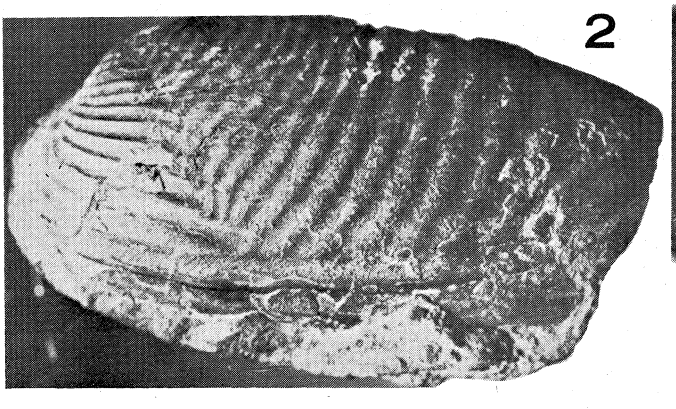

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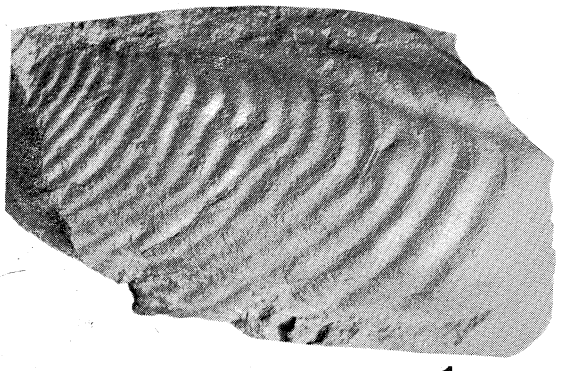

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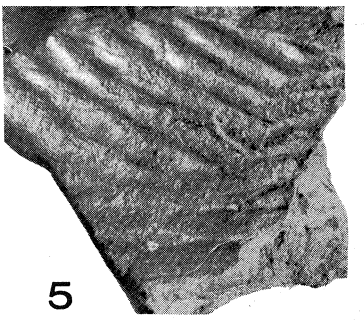

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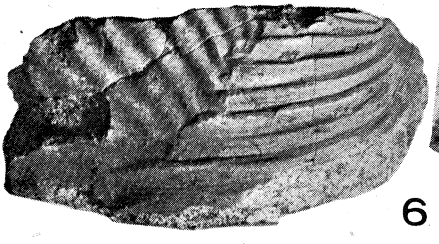

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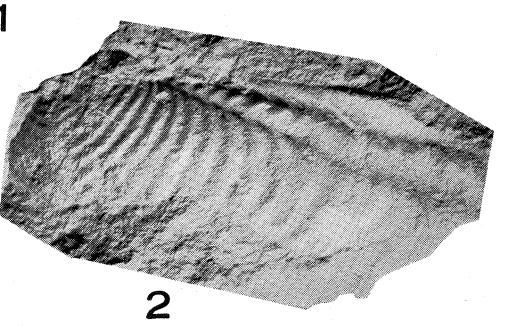

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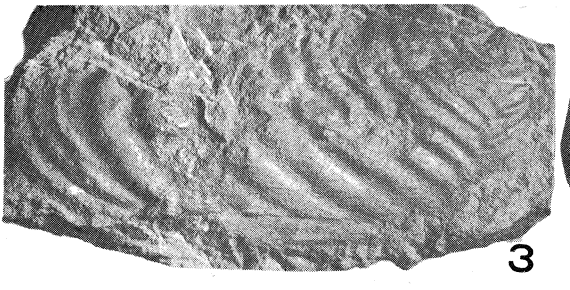

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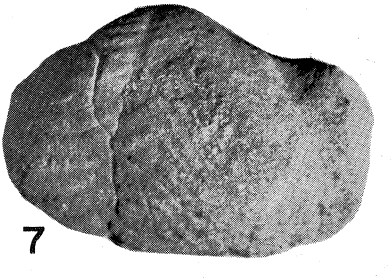

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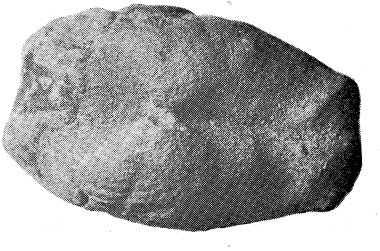

CORRIGENDA.

No. 7, 24 June, 1946.

FLETCHER, H. O. New Lamellibranchia from the Upper Permian of Western Australia. Pages 395–405, Plates xxxiv–xxxv.

The process blocks of the plates of this paper were inadvertently transposed. If Plate xxxiv is regarded as Plate xxxv, and Plate xxxv as Plate xxxiv, these will agree with the explanations and references in the paper.