

ELEVEN NEW SPECIES OF *AVICULOPECTEN* FROM CARBONIFEROUS ROCKS, MYALL LAKES, N.S.W.

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(Plates xlix.-lii.)

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The eleven new species of *Aviculopecten* described and figured below are divisible into three or more distinct specific groups, which appear in recently discovered fossiliferous beds on the shores of one of the Myall lakes for the first time in New South Wales. Two of the most characteristic of these groups include: (1) *Aviculopecten leggei*, *A. andrewsi*, *A. sparteus* and *A. perobliquatus*; (2) *A. argutus*, *A. flexicostatus* and *A. articulatus*. From Carboniferous rocks of the Burindi and Kuttung Series, no *Aviculopecten* closely allied to the species included in either of these two groups has been recorded. This, together with the advanced structural features displayed by the fossils in question, affords reasonable grounds for assuming that the geologic horizon of the Myall lake beds, from which the fossils now being dealt with were secured, is more recent than either of these two series. The Myall beds, therefore, may belong to the upper part of the Lower Carboniferous, or to the lower portion of the Middle Carboniferous system. On the evidence presented by the fossils these beds have yielded, it seems safe to place them as above. The following are some of the genera obtained: Brachiopoda: *Productus*, *Chonetes*, *Spirifer* (many new species); Lamellibranchiata: *Edmondia*, *Streblopteria* (?), *Aviculopecten* (described in this paper); Trilobita: *Cordania gardneri*.

All the *Aviculopectens* described in the present paper are from the beds referred to above outcropping on Brambles farm, Parish of Eurenderee, County of Gloucester, New South Wales. These beds have been tilted by an intrusion of igneous rock of diabasic appearance.

The species included in group (2) referred to above, have a closer general resemblance to the Viséan *Aviculopectens* described by the late Prof. de Koninck (Ann. Mus. Roy. d'Hist. Nat. Belg., t. xi.) than to any others it has been found possible to compare them with.

AVICULOPECTEN LEGGEI, n.sp. (Pl. xlix., fig. 1; Pl. l., fig. 12.)

Whole shell plano-convex, inequilateral, triangular, or fan-like. Left valve strongly convex near the umbo, and from there slopes steeply to the ventral margin. Radials consist of about twelve primaries, an equal number of secondary interpolations which begin near the umbo; towards the ventral margin a pair of

tertiaries is introduced, one on each side of a secondary; all are triangular in section and separated by concave spaces; umbonal ridges prominent and meet the cardinal margin at angles of 30° ; beak prominent, pointed and slightly incurved. Anterior auricle slightly convex, triangular, bears about six or seven radials; byssal sinus distinct. Hinge plate straight and shows three or more ligamental furrows. Posterior auricle missing. Neither on the body or auricle of this valve are concentric striae visible. A fragment of the right valve is present in apposition with the left, partly joined by the hinge; it is practically flat, smaller than the left one; radials dichotomous and not prominent. Dimensions of the left valve: length, 32.0; width, 25.0; depth, 4.0 mm.

This species, with *A. sparteus*, *A. perobliquatus* and *A. andrewsi*, forms a distinct and closely allied group, which as far as the present evidence shows, appears in these Myall lake beds for the first time in New South Wales, and seems not to have persisted through any great length of geologic time.

Dedicated to Mr. H. Legge of Legge's Camp, Myall lakes, N.S.W., who gave valuable help to the writer when collecting the fossils described in this paper.

AVICULOPECTEN FUSIFORMIS, n.sp. (Pl. xlix., fig. 2.)

Left valve fusiform, convex, medially ridged. Radials increased chiefly by interpolation, prominent, straight with a slight and gradually increasing curve towards the lateral margins from the medial longitudinal line; concentric striae very fine and numerous, but indistinct on testless valves; umbo prominent, pointed and reaches the cardinal margin. Anterior umbonal ridge prominent, falls steeply to the auricle and is short; posterior ridge long and ill-defined; with the cardinal line they form angles of 45° and 60° respectively. Both auricles are nearly perfect, the posterior one being much the larger; they are flat, triangular and crowded with almost microscopic transverse striae; the anterior one meets the cardinal line at an angle greater than a right angle, and its lateral margin is oblique; the latero-cardinal angle of the posterior one is about a right angle and its lateral margin mildly sinuate. Dimensions of a small left valve: length, 21.0; width, 31.0 mm.

Right valve unknown.

The species forms quite a singular type of the genus *Aviculopecten* as far as known Australian species are concerned. The distinguishing features of the species are (1) fusiform outline, (2) shoulder-like aspect of the anterior umbonal ridge, (3) almost microscopic fineness of the striae on the auricles, (4) pronounced dorso-ventral ridge, (5) disparity of the auricles in size.

AVICULOPECTEN PYRIFORMIS, n.sp. (Pl. xlix., fig. 3.)

Left valve pyriform, strongly convex, subequilateral, dorso-laterally sub-ridged, slopes more rapidly to the anterior lateral margin than to the posterior one. Radials numerous, slender, slightly interrupted in their course at one or more of the lati-concentric growth lines, consist of three orders. Lateral and ventral margins together form about two-thirds of an ellipse. Beak prominent, pointed and reaches the cardinal margin; umbonal ridges prominent and make with the cardinal margin angles of about 45° . Anterior auricle missing from the type specimen, but in another appears to be triangular with an oblique outer margin; posterior auricle larger than the anterior one, triangular, radials not visible, but traces of fine cross striae are plainly discernible, flat, lateral margin mildly sinuous. Hinge plate bears several ligamental furrows. Right valve un-

known. Cardinal margin about half as long as the length of the valve. On the body of the valve concentric striae are numerous. Dimensions of the type valve: Length, 50.0; width, 63.0 mm.

This species has some resemblance to the species just described (*A. fusiformis*), to which it is without doubt closely related; in dimensions the two forms differ widely and on this account they have been separated; but it may be pointed out also that on the hinge plate of *A. pyriformis* several ligamental furrows are distinctly visible; none such have yet been noticed on the hinge plate of *A. fusiformis*.

AVICULOPECTEN ANDREWSI, n.sp. (Pl. xlix., figs. 4-6.)

Shell of moderate size, valves very unequal.

Left valve very transverse, both posteriorly and anteriorly, strongly convex. Radials about twenty-eight in number, moderately prominent, ridged, apparently simple, and separated by concave spaces about twice as wide as themselves; concentric striae numerous, and on crossing the radials form distinct nodes. Beak prominent, pointed, and reaches the cardinal margin. Auricles over moderate size, wing-like, the anterior one smaller than the posterior and traversed by four or more indistinct oblique radials and numerous concentric striae, convex, clearly separated from the body, its outer border sinuate; posterior one depressed, of similar shape to the other, definitely separated from the body. Anterior umbonal ridge prominent, strongly curved or bow-shaped; posterior one long and less definite. Cardinal margin and hinge much shorter than the greatest length of the valve.

Right valve much shorter than the left one, very mildly convex; ribs numerous, indistinct, of two orders at least; concentric striae numerous but indistinct, ventral margin evenly rounded; auricles similar in shape to those of the other valve, but less definite, their radials and concentric striae similar in number and character to those of the opposing valve, but only faintly defined; anterior ear mildly convex, definitely separated from the body of the valve; lateral margin sinuous; posterior ear depressed, larger than the anterior one, radials and striae faintly defined; umbonal ridges low; beak not prominent. Dimensions of left valve: Length, 55.0; width, 45.0; hinge, 35.0 mm. Dimensions of right valve: Length, 30.0; width, 30.0 mm.

This is a well-marked species. Dedicated to E. C. Andrews, Esq., B.A., Government Geologist of New South Wales.

AVICULOPECTEN SPARTEUS, n.sp. (Pl. l., fig. 7; Pl. lii., fig. 23.)

Left valve obliquely transverse, inequilateral, strongly convex, outline like that of a yard broom which has been in use for some time, laterally produced anteriorly and posteriorly; ribs prominent, increased by several interpolations, strongly directed towards the lateral margins, bear traces of nodes; concentrically sub-wrinkled. Anterior umbonal ridge prominent and subcurved, posterior one indefinite; umbo absent, but was evidently prominent; auricles absent? What is taken to be the right valve of the species is sub-equilateral, very mildly convex, much smaller than the left valve; ribs faint, apparently of two orders, sub-concentrically wrinkled. Umbonal ridges moderately prominent, enclosing an angle of about 105° , anterior one slightly curved; ventral margin evenly rounded. Auricles triangular, of about equal size, posterior one flat, shows faint traces of very fine cross striae, but no radials visible, meets the cardinal line at nearly

a right angle; anterior ear damaged, very mildly convex, clearly separated by a sulcus from the body. Cardinal margin approximately half as long as the length of the valve. Hinge plate narrow, exhibits one ligamental furrow and a small resiliifer. Beak prominent and barely reaches the cardinal margin. Dimensions: Right valve, length, 30.0; width, 20.0 mm.; left valve, length, 40.0; width, 28 mm.

If the right valve here assumed to belong to this species, proves really to be so, it will become a question whether it should be placed in the genus *Deltopecten* Etheridge and Dun; but when determining this question it must not be overlooked that some American palaeontologists have so amended McCoy's original description of the genus *Aviculopecten* as to include the presence of a resiliifer (Grabau and Shimer, North Am. Ind. Foss., 1909, Vol. I).

This species and *perobliquatus* bear some resemblance to each other, but are easily distinguished one from the other.

AVICULOPECTEN PEROBLIQUATUS, n.sp. (Pl. I., figs. 8, 9.)

Whole shell very oblique, subplanconvex, very inequilateral. Left valve larger than the right, strongly convex, obliquely subtrapezoidal; ribs numerous, apparently of three orders, separated by narrow interspaces; concentric striae numerous, but indistinct on the testless specimens, which alone are available, but show an imbricate pattern. Anterior auricle absent; posterior one imperfect, large, triangular, radials and concentric striae indistinct; beak absent, but appears to have been prominent. A medial umbonal ridge obliquely traverses the medial part of the valve. Right valve only mildly convex, oblique, much smaller than the left, bears several ill-defined concentric folds, ribs and concentric striae faint, the former seem to be simple. Anterior auricle imperfect, small, clearly separated from the body by the byssal sinus; outer margin rounded; posterior ear large, depressed, and faintly radiated. Umbonal ridges prominent; beak prominent, reaches the cardinal margin, which is much shorter than the length of the shell. Some ribs of the right valve as they approach the latero-ventral margin, assume a zig-zag course. This feature is present in several of the species of *Aviculopecten* from the Myall Lakes, and is one that has not been observed by me in any species of the genus from elsewhere. The valves, described above, are conjoined by the hinges, but are widely agape ventrally. Dimensions: Left valve, length, 47.0; width, 30.0 mm.; right valve, length, 35.0; width, 25.0 mm. Length of hinge, 22.0 mm. The umbonal ridges of the right valve diverge from the beak at angles of about 30° and 45° and include an angle 105° approximately.

This is one of the most oblique of *Aviculopectens* and in that respect surpasses all others which have come under my notice.

AVICULOPECTEN ARGUTUS, n.sp. (Pl. I., figs. 10 and 11.)

Outline of the shell suborbicular, mildly biconvex and of moderate size. Left valve mildly and evenly convex. Radials numerous, consist of primaries and an interpolation of a secondary between each pair of primaries, except in one case where two secondaries are interpolated between a pair of primaries, concentric striae numerous and form nodules on the radials; beak and auricles absent. Right valve mildly convex, smaller than the left, almost smooth for the radials are only faintly visible on testless valves. Beak slightly defective, but

prominent and pointed. Auricles only partly preserved; the anterior one clearly separated from the body by the byssal groove; umbonal ridges moderately distinct. Dimensions of the right valve: Length, 37.0; width, 35.0 mm. approx.

The distinctive features of the species are (1) the single interpolation between each pair of primaries; (2) stoutness of the primaries; (3) slight convexity of the right valve and its relative smoothness; (4) flexuring of the radials from their normal course at one or more of the laticentric striae, in this respect resembling *A. flexicostatus*, also described in the present paper.

The two valves described above are in apposition.

AVICULOPECTEN FLEXICOSTATUS, n.sp. (Pl. l., figs. 13-16; Pl. lii., figs. 21 and 22.)

Left valve orbicular, mildly and evenly convex, slightly inequilateral. Radials very numerous, of three orders, distinct, but not prominent; concentric striae very numerous, fine, regularly spaced, and produce with the radials a neat cancellate pattern. Umbo depressed, pointed, barely reaching the cardinal margin. Anterior umbonal ridge short, falls vertically to the ear, and makes with the cardinal line an angle of about 45° . Posterior ridge less prominent and longer than the other; makes with the cardinal line an angle of about 30° . Ears of nearly equal size, triangular, bear six radials, and crowded concentric striae. Cardinal margin and hinge plate straight, less than half as long as the greatest length of the shell. Right valve, or what is assumed to be such, less convex than the other, nearly flat towards the ventral margin, but in other respects resembles the left valve. Dimensions of left valves: Length, 50.0, 40.0, 37.0; width, 46.0, 36.0, 34.0 mm. The measurements are approximate in each case.

This *Aviculopecten* bears a general resemblance to *A. caelatus* McCoy, and also to *A. plagiostomus* de Koninck, both of which are found in the Carboniferous Limestone of Visé (étage III.) of Belgium.

AVICULOPECTEN PINCOMBEI, n.sp. (Pl. li., fig. 18; Pl. lii., figs. 19, 20.)

Shell moderately large. Left valve convex, tumid near the umbo, subdepressed adjacent to the postero-lateral margin; ribs thirty to thirty-three, according to size, simple except for an odd interpolation in some specimens, mildly ridged, and separated from each other by wide slightly concave spaces. Concentric striae very numerous, distinct, produce mild echination or imbrication of the ribs as these are crossed by them. The anterior and ventral margins are neatly rounded, the latter one forming a semicircle; posterior margin from the ear to the ventral one straight and oblique; umbo prominent, blunt, and just reaches to the cardinal border. Anterior auricle triangular, very mildly convex, emarginate at its junction with the body, rounded at the cardinal angle, bears some four or five gently oblique indistinct radials; and numerous fine concentric striae; byssal sinus distinct. Posterior auricle much larger than the anterior one, subwing-shaped, openly emarginate, ornamentation similar to that of the anterior one, rounded at the cardinal angle, outer margin mildly sinuate, indefinitely separated from the body. Anterior umbonal ridge prominent and makes an angle of 45° with the cardinal border; posterior umbonal ridge indefinite.

Cardinal border and hinge plate straight, more than half as long as the length of the valve. A specimen with the valves in apposition shows the hinge plates slightly agape, indicating the presence of a strong ligament.

An indifferently preserved cast of the two valves of this shell in apposition

shows the right valve to be very mildly convex in the vicinity of the large muscular area, and towards the lateral and ventral margins to be slightly concave; ribs indistinct, apparently simple and secondary, and on the muscular area they are not visible. Outline of the two valves conjoined is that of a segment about equal to five-sixths of a complete circle. Dimensions of left valves: Length, 80.0, 60.0, 60.0; width, 65.0, 55.0, 55.0 mm; depth, 15.0 mm.

The description above was made from testless specimens, except in the case of one left valve. This *Aviculopecten* is quite a conspicuous one. In some features it resembles *A. granosus* J. de C. Sowerby, from the Middle Carboniferous Limestone of Ireland and Belgium, but is specifically far removed from it.

Dedicated to T. H. Pincombe, Esq., B.A., who, with Mrs. Pincombe, was associated with the writer when the specimens here described were collected.

AVICULOPECTEN PLICATILIS, n.sp. (Pl. lii., fig. 25.)

Right valve mildly convex, sides subparallel, ventral margin rounded; radials indistinct, dichotomous, almost invisible towards the posterior margin; beak subprominent; anterior auricle triangular, clearly separated from the body of the shell by the byssal sinus; posterior auricle aliform, pointed, very indefinitely separated from the body; both auricles bear fine curved concentric striae, but are otherwise smooth; cardinal margin long and straight; hinge plate long, narrow and bears one distinct ligamental furrow; the cardinal margin and hinge plate are much longer than the shell. Left valve unknown. Dimensions of the right valve: Length, 15; width, 16 mm.

This *Aviculopecten* resembles in outline and ornamentation, some Pterineas (*P. brisa* for instance). Among Australian *Aviculopectens*, as far as I am aware, it is singular.

It may be noted further that this form is very near to *Aviculopecten* (*Pecten*) *megalogis* McCoy. The ornamentation of the two is alike as far as their radials and concentric striae are concerned; but the local form has a more pointed and aliform posterior auricle and a larger anterior auricle than are possessed by the Irish form, and is also much larger.

EXPLANATION OF PLATES XLIX.-LII.

Plate xlix.

1. *Aviculopecten leggei* Mitchell. A left valve minus the posterior auricle and hinge plate. Portion of the right valve is attached to it by the hinge. On the anterior part of the hinge plate of the latter, two or three ligamental furrows are visible (x 2 nearly).
2. *Aviculopecten fusiformis* Mitchell. A nearly perfect left valve (x 2).
3. *Aviculopecten pyriformis* Mitchell. A large left valve, minus the anterior ear, and having the postero-lateral margin slightly defective (slightly enlarged).
4. *Aviculopecten andrewsi* Mitchell, showing the two valves conjoined, but widely gaping ventrally (x 1½).
5. Left valve of the above (x 1½). An almost perfect specimen exhibiting the ornamentation clearly.
6. A photo of a right valve, taken under a strong oblique light to show up the faint radials (slightly enlarged).

Plate 1.

7. *Aviculopecten sparteus* Mitchell. A left valve of which the figure is a good one; the auricles and beak are absent; the nodes on the radials are clearly visible (x 2 approx.).

8. *Aviculopecten perobliquatus* Mitchell. An almost perfect right valve (x 1.4).

9. The left valve of the above, with which it is in apposition. The whole of the anterior auricle, part of the posterior auricle and part of the ventral margin are missing (x 1.6).

10. *Aviculopecten argutus* Mitchell. A good photo of a defective left valve (slightly enlarged).

11. The right valve of the above with which it is in apposition; both auricles and the anterior lateral margin are defective (x 1.6).

12. The right valve of *A. leggei*. It is joined by the hinge to the left valve (Pl. xlix., fig. 1); (x 2 nearly).

Plate li.

13, 14. *Aviculopecten flexicostatus* Mitchell. Two photos from an intaglio (cover) of a left valve, and wrongly represent the radials, in part at least, to be dichotomous. This happens because in such a specimen the interspaces of the radials, are in relief instead of the radials themselves. The photos otherwise show the external ornamentation of an immature valve very distinctly (x 2.3 and $1\frac{3}{4}$ respectively).

15, 16. Left valves of the same species, showing the radials correctly; 15 represents a mature specimen (x 1.6 and 2 respectively).

17. *Aviculopecten articulatus* Mitchell. A view of the valves in apposition, from the left side; about half of the left is broken away and exposes the right one in part. The peculiar jointing of the radials of the left valve at the latit-concentric growth lines is clearly visible.

18. *Aviculopecten pincombei* Mitchell. Side view of a cover of a left valve (nat. size).

Plate lii.

19. A very fine left valve of the same, partly testiferous (x 8/7).

20. A cast of a right valve in apposition with its left valve; the hinge plates are shown agape, and the muscular area subcentral. The circular object towards the posterior margin is a foreign body which pierces both valves (x 1.3).

21. What is assumed to be the right valve of *A. flexicostatus*. The margins are defective (x 2).

22. A fragment of the cover of a left valve of *A. flexicostatus*, clearly showing the ornamentation and the flexuring of the radials (x 2 approx.).

23. The right valve of *A. sparteus*.

24. A small left valve of *A. perobliquatus* (enlarged).

25. A right valve of *Aviculopecten plicatilis* Mitchell showing the features of a testless specimen fairly well (x $1\frac{3}{4}$).



1924. "Eleven new species of Aviculopecten from Carboniferous rocks, Myall Lakes, N.S.W." *Proceedings of the Linnean Society of New South Wales* 49, 468–474.

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