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CONTRIBUTIONS ON THE PERMO-CARBONIFEROUS AVICULOPECTINIDÆ OF NEW SOUTH WALES.*

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with an Introduction by

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(Plates i-xvi and Figures 1-6.)

Introduction.

In 1927 the Australian Museum acquired the collections of Mr. Varney Parkes. This assemblage of fossils, upwards of five thousand specimens, is the result of thirty years' careful and assiduous field work, more particularly in the Illawarra district of New South Wales.

This area has been the subject of considerable geological work which has been recorded by Strzelecki, Dana, W. B. Clarke, T. W. E. David, L. F. Harper, C. F. Laseron, Miss Ida Brown, and others. The specimens described in this paper are from the stage named by David "Nowra grits" in the Upper Marine Series of the Permo-Carboniferous, and may be regarded as supplementing the collection in the Mining and Geological Museum, Sydney, that described by John Morris in Strzelecki's "Physical Description of New South Wales and Van Dieman's Land," Dana's collection now preserved at Washington, and Clarke's described by De Koninck and destroyed by fire in 1882.

The collection is particularly rich in Pelecypoda, and the Aviculopectinidae have been selected as the subject of the first paper

* Where not otherwise designated the various specimens are from the Varney Parkes collection.

on account of the wealth of specimens and their generally excellent preservation, taking into consideration the usually unfavourable matrix.

Mr. Fletcher's descriptions may be regarded as supplementary and emendatory of those by Etheridge and Dun, the greater series having enabled him to enlarge the range of variation of certain species and with these points I am in agreement.

Interesting features in the Pecten fauna of the Australian Permo-Carboniferous are the large size of species of Aviculopectens and Deltopectens and the particular development of the last named genus. Its distribution beyond Australia has been recorded by Y. T. Chao,[1] who describes two species of *Deltopecten, giganteus* and *multistriatus*. In speaking of his *giganteus*, a form of large size and very similar to Australian forms, Chao remarks: "excepting the greater convexity of the umbonal region, the surface of this valve (left) is marked essentially by the same kind of sculpture as those of the right valves, a fact very unusual in the genus *Deltopecten*, in which the left valve is generally characterised by more robust surface sculptures."

Deltopecten is separated from *Aviculopecten* by an internal character which is observable only under certain conditions of preservation, hence in many cases the exact generic terminology of many of our Aviculopectinidæ is uncertain. Girty remarks[2]: "there occur a number of forms whose internal structures are unknown and whose generic position with *Aviculopecten,* as against *Pecten, Deltopecten,* and possibly other genera, is as yet to be demonstrated." The same author's remarks[3] on *Deltopecten,* with which he makes his *Limipecten* a synonym, are of great interest. From the Caney Shale he describes *Deltopecten* (?) *caneyanus.* From the Moorefield Shale of Arkansas he describes *D. batesvillensis* Weller, and *D. sp.*,[4] and from the Wewooka Formation of Oklahoma, *Deltopecten texanus* Girty, *D. vannleeti* Beede. It is more than probable that further examination will prove the presence of *Deltopecten* in European Carboniferous Permian faunas. The late H. S. Bion records[5] a *Deltopecten* cf. *illawarrensis* from the Kashmir; there is, judging from the description and figures, no evidence as to the generic affinity beyond the surface ornamentation.

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[1] Chao.—Fauna of the Taiyuan Formation of North China—Pelecypoda. Pal. Sinica, (B), ix, 3, 1927, pl. iii, figs. 1-3, pl. iv, figs. 1-3, pl. ii, fig. 22, pl. iii, figs. 4-6, pl. iv, fig. 4.

[2] Girty.—The Guadalupian Fauna. U.S. Geol. Surv., Prof. Pap. 58, 1908, p. 432.

[3] Girty.—The Fauna of the Caney Shale of Oklahoma. U.S. Geol. Survey, Bull. 307, 1909, pp. 30-31.

[4] Girty.—U.S. Geol. Surv., Bull. No. 439, 1911, p. 89, pl. xi, figs. 1-4.

[5] Bion.—Fauna of the Agglomeratic Shale Series of Kashmir. Pal. Indica (n.s.), xii, 1928, p. 36, pl. ii, fig. 9, and pl. iii, fig. 1.

The registration numbers of specimens of Aviculopectinidae figured in Memoirs of the Geological Survey of New South Wales, Palæontology, no. 5, vol. ii, part 1, 1906, are as follow:—

(A). SPECIMENS IN THE MINING AND GEOLOGICAL MUSEUM, SYDNEY.

	Plate.	Figure.	Registered Number.
Aviculopecten englehardti Eth., Jr., and Dun	IX	6	F.2572
	IX	7	F.2603
	IX	8	F.2599
	IX	9	F.2573
	IX	10	F.2571
	IX	11	F.2557
	XIV	6	F.6645
	XIV	7	F.6645
	XIV	8	F.6645
Aviculopecten mitchelli Eth., Jr., and Dun ..	I	3	F.6632
	II	1	F.2615
	I	1-2	F.6643
	X	5	F.6635
	XII	5	F.2578
	XIII	3	F.6641
	XVI	3	—
Aviculopecten ponderosus Eth., Jr., and Dun	V		F.6633
	XII	4	F.2575
Aviculopecten profundus De Koninck	XI	5	F.2606
	XI	4	F.6626
Aviculopecten ptychotis (McCoy)	XV	5	F.1749
	XV	6-7	F.1760
Aviculopecten sprenti Johnston	II	7	F.6649
	II	—	F.2588
	II	6	F.2614
	XII	1	F.6637
	XIII	1	F.6648
	XIII	9	—
	XVI	5-6	—
Aviculopecten squamuliferus (Morris)	I	4	F.2579
	II	4	F.2596
	II	5	F.2614
Aviculopecten tesselatus (Phillips)	XV	5	F.1763
	XV	9	F.6646
Aviculopecten sp. Eth., Jr., and Dun	XV	10	F.4605
	XV	11	F.4553
	XV	12	F.4634
Aviculopecten tenuicollis (Dana)	XIII	10	F.2589
	XIII	11	F.2595
Deltopecten farleyensis Eth., Jr., and Dun ..	XIII	4	F.2587
	VI	2	F.2584
	XIII	5	F.6639
	XIII	6	F.6638
	XVI	4	—

	Plate.	Figure.	Registered Number.
Deltopecten fittoni (Morris)	X	6	—
	VIII	1	F.2617
	VIII	2	F.2620
	VIII	3	F.2619
	XVI	1	F.6315
Deltopecten illawarrensis (Morris)	II	2	F.6628
	II	3	F.6631
Deltopecten leniusculus (Dana)	VII	2	F.6636
	IV	—	F.6644
	III	1	F.2574
	VI	1	F.2575
	VII	1	F.2576
	X	1-2	F.2582
	XI	3	F.3127
Deltopecten limæformis (Morris)	X	4	F.6629
	X	3	F.10861
Deltopecten obliquatus Eth., Jr., and Dun ..	XIII	7	F.2616
Deltopecten subquinquelineatus (McCoy) ..	XIII	2	F.6628
	XIII	8	F.6634
	XII	1-2	F.6640
	IX	2	F.6642
	IX	5	F.2578a
	III	2	F.2622
	LX	1	F.2624
Deltopecten wingenensis Eth., Jr., and Dun	XIV	2	F.5142
	XIV	3-4	F.5143
Deltopecten sp. Eth., Jr., and Dun	IX	12	F.6308
Entolium aviculatum (Swallow)	XV	4	F.6630
	XV	1	F.1777
	XV	2	F.1778
	XV	3	F.1779

(B). SPECIMENS IN THE AUSTRALIAN MUSEUM.

	Plate.	Figure.	Registered Number.
Aviculopecten squamuliferus (Morris)	VIII	4	F.116
Deltopecten subquinquelineatus (McCoy) ..	IX	3-4	F.14233
Deltopecten limæformis (Morris)	XI	1-2	F.17498

DESCRIPTIONS OF SPECIES.

AVICULOPECTEN SQUAMULIFERUS (*Morris*).

Pecten squamuliferus Morris, Strzelecki's Phys. Descript. N. S. Wales, 1845, p. 278, pt. xiv, f. 1.

? *Aviculopecten multiradiatus* Etheridge, Quart. Journ. Geol. Soc., 1872, xxviii, p. 327, pl. 13, f. 1.

Aviculopecten squamuliferus (Morris), Etheridge, Jr., and Dun, Mem. Geol. Survey of N.S.W., Palæontology, No. 5, Vol. ii, part 1, 1906, p. 8 and figs.

Observations.—The specimens of this species, figured by Etheridge and Dun in their monograph are before me, but there is nothing which can be compared to them in the large Varney Parkes collection.

The original description by Morris has already been discussed by Etheridge and Dun as being "quite insufficient for the recognition of this species, and, were it not for the figure, it would be necessary to relegate the name to the rejectamenta." These authors possessed four examples of convex valves, and they added many details to the description. Apparently the only known specimens of this species are these four convex valves, and the specimen figured by Morris.

The specimens that Etheridge and Dun examined were, according to those authors, four of the convex valves and in the explanation of the plates were called right valves. This is contrary to the usual rule of the Aviculopectens, in that the left valve is usually the more convex of the two. The valves must be regarded as right valves and are slightly convex, so apparently we may assume from this that the unknown left valve is far more convex than the slightly convex right valves, from which apparently descriptions have so far been compiled.

An examination of Morris' figure and Etheridge and Dun's figured specimens prove them to be identical, except the specimen figured on plate 1, figure 4, which in my opinion should be referred to my species *A. largis*.

A great number of specimens closely allied to *A. squamuliferus* is contained in the collection, and these fall into distinct types according both to ornamentation and size, but none of them can be placed with the above species. A glance at the localities from which the specimens of *A. squamuliferus* were collected, proves the species to be characteristic of the Lower Marine Series of the Permo-Carboniferous. Its absence in the Varney Parkes collection is therefore not surprising, as the majority of the specimens were collected from the Upper Marine Series of the South Coast of New South Wales.

Further details are added to Etheridge and Dun's description in order to prevent confusion with several closely allied new species.

Description.—Right or flat valve as wide as long; inequilateral and considerably depressed, only slightly swollen in the umbonal

region. Dorsal margin not as wide as body of valve. Posterior and anterior slopes short and straight, diverging rapidly towards the lateral margins of valve. Ventral margin extensive and rounded. Posterior auricle slightly smaller than the anterior auricle, both, especially the anterior, separated from the body of the valve by distinct sinuses, which in the impression appear as ridges. The anterior byssal sinus is of comparatively large size. Anterior auricle large and triangular, the outer margin rounded, while the posterior auricle is strongly convex, with an obliquely truncate outer margin.

The surface is marked by primary radiating plications or costæ, fifty in number, closely arranged and sharp. Occasionally there may be interpolated secondary costæ, which originate at the umbonal region and, like the primary, spread out radially towards the margin. The secondary costæ are, however, rare, and when present remain inferior in size to the primary costæ. Concentric growth lines are indistinct in early stages of shell but become more distinct towards the ventral margin of the shell.

The entire sculpture of the valve is crossed by a fine concentric lamination or frill imbrication, which increases in density towards the ventral margin. It is confined more to the intercostal spaces, the tops of the radiating costæ being more or less free from lamination.

The ornamentation on the ears is somewhat similar to the valve ornamentation; the anterior ear possesses six to eight radiating costæ, which occasionally bifurcate. Lamination is also present, and the growth lines become particularly heavy at the extremity. Posterior valve ornamentation consists also of radiating primary costæ, but these are more or less obscured by the numerous well developed concentric growth lines.

The left or convex valve is unknown.

The dimensions of a right valve figured by Etheridge and Dun on plate viii fig. 4 are approximately as follows:—

Height, 86 mm.; width, 88 mm.; dorsal margin, 80 mm.

Localities and Horizon.—New South Wales: Farley (J. Waterhouse); Ravensfield (J. Waterhouse); Pokolbin (C. A. Süssmilch). Tasmania: Huon Road. *Permo-Carboniferous,* Lower Marine Series.

Collection.—Mining and Geological Museum and Australian Museum, Sydney.

AVICULOPECTEN EXTENSUS, *sp. nov.*

(Plate i.)

Description.—The shell is of medium size, equilateral (without ears), and both valves very slightly convex. Valve more or less fan-shaped, being much higher than wide. Dorsal margin as

wide as body of valve. Umbonal region slightly swollen, and the beak is pointed but by no means conspicuous; anterior and posterior margins of valve narrow dorsally but diverge below the ears to form a rather extensive semi-circular ventral margin. The anterior auricle triangular, moderately large, the outer margin rounded, and separated from the valve by a byssal sinus. The posterior auricle is the smaller of the two, with a straight outer edge, and is separated from the rest of the valve by a very slight depression.

The surface of the valves is marked by a series of radiating primary costæ, thirty-five to forty in number, sub-angular, irregularly spaced and varying in size and strength. Occasionally secondary costæ may be interpolated and may be either distinct or result from a bifurcation of a primary costa. Concentric lines marking the growth stages of the shell are distinct and become moderately heavy on the ventral margin. The intercostal spaces or depressions are broad and concave. The anterior ear possesses six radiating costæ which bifurcate, the whole being crossed by a very fine but distinct lamination. The posterior ear is ornamented with fine costæ and these are also crossed by the concentric lamination. Hinge plate straight, and linear.

The dimensions are approximately as follows:—

	Fig. 2.	Fig. 3.	Fig. 1.
Height	73 mm.	75 mm.	73 mm.
Width	60 mm.	58 mm.	65 mm.
Dorsal margin ..	53 mm.	52 mm.	51 mm.

Observations.—The species is represented by a number of right valves and a left valve, all in an excellent state of preservation, and in several instances practically perfect.

It is a very distinct species and is apparently restricted to the Upper Marine Series. *A. squamuliferus* Morris bears a general resemblance to this species, but the chief points of difference may be summed up as follows:

(*a*) *A. extensus* is much higher than wide, whereas *A. squamuliferus* is as wide as, or wider than its height.

(*b*) The posterior ear or auricle in *A. extensus* is far smaller than the anterior ear. In *A. squamuliferus* the ears are equal, or the posterior ear may be the larger of the two.

(*c*) The valve sculpture on both species consists of primary costæ with occasional interpolated secondaries. In *A. extensus* however they are stouter and not nearly as numerous as on *A. squamuliferus.*

(*d*) The frill imbrication or concentric lamination so characteristic of *A. squamuliferus,* although present in *A. extensus,* is so indistinct that it may be discerned only after a close examination.

Locality and horizon.—Coast line between St. George's Basin and Ulladulla, New South Wales. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Type specimen, F.19143; paratypes, F.19194 and F.19144.

AVICULOPECTEN MULTICOSTATUS, *sp. nov.*

(Plate ii.)

Description.—The shell is of moderately large size, more or less subcircular in outline. The right valve is considerably flattened and is inequilateral. Dorsal margin equals about two-thirds the width of the body of the valve. The beak is slightly posterior in position on the hinge line and is pointed and insignificant. Umbonal ridges short, terminating practically at the base of the auricles after which the outline of the shell is semicircular. Anterior ear much greater in size than the posterior ear, which is exceedingly small. Anterior auricle slightly convex, triangular, with a rounded outer margin, and sharply marked off from the remainder of the shell by a distinct byssal sinus. Posterior ear is also triangular, with a straight outer margin.

The sculpture of the valve consists of radiating costæ, concentric growth lines, and a frill imbrication or lamination. The main costæ are about thirty to thirty-five in number, 4-6 mm. wide, flattened and separated by comparatively narrow intercostal spaces. In the umbonal region these costae are devoid of interpolated secondary costæ, but are augmented towards the ventral margin by being traversed along the lateral margins by two fine ribs, dividing each primary costæ into three. Concentric growth lines are numerous, becoming stronger towards the later stages of growth. A fine frill imbrication traverses the whole of the surface ornamentation, giving the shell a characteristic perforated appearance. The sculpture of the anterior ear consists of six to seven primary costæ, crossed by numerous growth lamellæ, which are always more pronounced upon the ears. The posterior ear is practically devoid of costæ, and consists almost solely of fine and sharp growth lamellæ.

The left valve is represented by several specimens, all of which are strongly convex. The surface sculpture of the valve is essentially the same as that of the right valve.

The dimensions of several of the figured specimens, including the holotype, are approximately as follows:

	Fig. 1. (Holotype.)	Fig. 3. (Paratype.)
Height	136 mm.	190 mm.
Width	120 mm.	160 mm.
Dorsal margin	72 mm.	120 mm.

Observations.—This species is represented by a number of exceedingly well preserved specimens from the Upper Marine Series of the South Coast of New South Wales. In the type locality this form was particularly abundant, and a large block in the collection is practically composed of nothing else but valve fragments. As it has not to my knowledge been collected from any other locality, this species no doubt had a very restricted distribution.

In shape and general appearance it resembles *A. squamuliferus,* but may be quite readily distinguished from the latter by its larger size, distinct ornamentation, and the small size of the posterior auricle. It agrees with *A. squamuliferus* in possessing a frill imbrication, which gives the valve an appearance of being perforated.

Localities and horizon.—New South Wales: St. George's Basin; coast line between St. George's Basin and Ulladulla; Kangaroo Point, St. George's Basin. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Holotype, F.19097; paratypes, F.19513 and F.19377 (Figures 1-3 respectively).

Aviculopecten sprenti *Johnston.*

Plate iii and Figure 1.)

Aviculopecten sprentii Johnston, Proc. Roy. Soc. Tas., 1886 (1887), p. 9.

Aviculopecten sprentii Johnston, Syst. Acct. Geol. Tas., 1888, p. 115, pl. xiv, fig. 11.

Aviculopecten sprenti, Etheridge, Jr., and Dun, Mem. of the Geol. Survey of N.S.W., Palæontology, No. 5, Vol. ii, 1906, p. 15 and plates.

Observations.—There are many specimens of this dainty Palæopecten in the Varney Parkes collection. These are usually preserved in the form of left valve impressions and moulds, but in several instances the complete shell, consisting of both valves, has been preserved.

This is the first time that the right or flat valve has been recorded, for no mention of it was made in Johnston's original description, while in Etheridge and Dun's description it is stated that the right valve is unknown. I have therefore taken the opportunity of figuring the right valve and adding further details and measurements to the descriptions already published.

Description.—The shell is of small size, suborbicular, equilateral (without ears) and inequivalve. Dorsal margin or hinge line as long as the width of the shell, which is as high as or higher than wide. The left valve is convex, with short anterior and posterior slopes rapidly converging to the beak, which is sharp and pointed and overhangs the right valve. Umbonal margins slightly concave, diverging laterally at half the height of the shell. Ventral margin broadly rounded, giving the shell a fan or scallop-shaped appearance. Posterior auricle comparatively large, triangular, outer margin obtusely rounded and becoming pointed at the antero-dorsal angle; smaller than anterior auricle, which is also triangular with a rounded outer margin. Anterior ear is more sharply marked off from the remainder of the shell by a distinct byssal sinus.

The sculpture of the left valve consists of primary, secondary, and tertiary costæ. The first are ten to fourteen in number, and are strong and acutely rounded. In the intercostal spaces a secondary rib occupies a median position, and on either side a small tertiary rib is interpolated. The secondary and tertiary costæ are slender and become pronounced only towards the base of the shell. In the umbonal region only primary and secondary costæ are present.

The auricles possess sculpture somewhat similar to that of the valve surface except for the absence of tertiary costæ. The anterior ear is ornamented with four primary and concentric lines of growth. The posterior ear possesses three to four primary costæ with a secondary costa in each intercostal space.

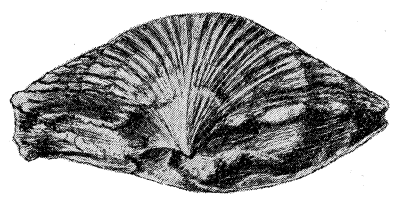

Figure 1.

The right valve is considerably flattened, being slightly convex only in the umbonal region. Ears are absent in all my specimens. The ornamentation of the valve consists of some forty to fifty fine radiating costæ, all regularly arranged and of the same size. The surface of the left valve is, according to Etheridge and Dun, "traversed concentrically in the first instance by latilaminæ, in the second by close frills, which, on passing over the primary and secondary costæ, and on the auricles, rise into acute echinations (almost spines) at regular intervals; there is also a prominent series of denticles along the dorsal margin." This peculiarity is shown to advantage on many of the specimens before me.

Dimensions of several complete and well preserved specimens are approximately as follows:

	Fig. 6.	Fig. 5.	Fig. 4.
Height	40 mm.	32 mm.	29 mm.
Width	38 mm.	32 mm.	27 mm.
Dorsal margin ..	32 mm.	22 mm.	—

Localities and horizon.—New South Wales: Wyro, near Ulladulla; coast line between St. George's Basin and Ulladulla; Tullawalla Point, St. George's Basin; Ulladulla; Gerringong.

Collection.—The Australian Museum, Sydney.

Registered numbers of figured specimens.—Pl. iii, fig. 1, F.19540; pl. iii, fig. 2, F.19536; pl. iii, fig. 3, F.19491; pl. iii, fig. 4, F.19491; pl. iii, fig. 5, F.19412; pl. iii, fig. 6, F.19585.

AVICULOPECTEN GRACILIS, *sp. nov.*

(Plate iv, and Figure 2.)

Aviculopecten media Laseron (pt.), Journ. and Proc. Roy. Soc. of N.S.W., xliv, 1910, pp. 203-4, pl. xv, figs. 2-3.

Description.—The shell is small with a subcircular outline and much higher than wide. The largest specimen attains a height of 37 mm.

The left valve is strongly convex, with a sharp pointed beak median in position and overhanging the hinge line. Anterior and posterior slopes rapidly converge to the umbo. Ventral margin broad and extensive. Anterior auricle larger than the posterior, triangular, with a rounded outer margin, and separated from the body of the valve by a distinct byssal sinus. The posterior auricle is also marked off by a sinus. The anterior lateral portion of the umbonal region is quite flattened, while the postero-lateral margin is rounded.

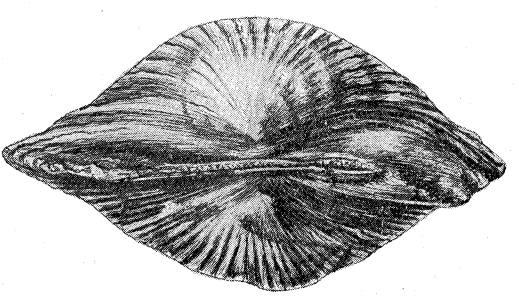

Figure 2.

The surface is marked by radiating primary costæ and concentric lines of growth. The primary costæ originate at the apex of the umbo, where they are sharp and slender, but become more prominent and strong towards the ventral margin. They are twenty-five to thirty in number, and in the later stages of the shell are rounded on top and separated by fairly wide and smooth intercostal spaces. The lines of growth are more pronounced in some specimens than in others, and consist of lamellæ which are very distinct on the tops of the costæ, where they almost form spines or echinations. The ear sculpture is essentially the same as the valve sculpture, the anterior ear possessing eight to ten primary costæ, which occasionally bifurcate, while the posterior ear possesses only five to six. Growth lamellæ are very pronounced on both auricles, particularly on the outer margin. Hinge line straight and almost equal to the greatest width of the shell.

The right valve is not so strongly convex as the left valve and is smaller, the beak not quite extending to the hinge line. Umbonal region has both margins rounded, with a distinct byssal sinus separating the anterior ear from the body of the valve. The ears are similar to those of the left valve. The surface ornamentation is identical with that of the corresponding valve.

The dimensions of several of the figured specimens, including the holotype, are approximately as follows:

	Pl. iv, fig. 1. Holotype.	Pl. iv, fig. 4. Paratype.
Height	38 mm.	25 mm.
Width	34 mm.	21 mm.
Dorsal margin	30 mm.	18 mm.

Observations.—This small and delicate looking Palæopecten is an outstanding type, and one which could not very well be confused with other species of *Aviculopecten*. One could perhaps refer to it as a minute form of *A. squamuliferus* as the surface sculpture is very similar. The strong convexity of both valves and its small size, however, prohibits it being placed with this species.

I have included among the specimens of *A. gracilis*, one of Laseron's type specimens of his *Aviculopecten media*. This author founded his species on two specimens collected from the Wandrawandian Series at Burrier on the South Coast of New South Wales. One was an imperfect right valve with a well preserved auricle, while the second specimen was a nearly perfect cast of the united valves. This latter specimen I have placed with *A. gracilis*, as its characters correspond with those of my species, and not with the characters of *Deltopecten media*, as further specimens which I have at hand prove. It is interesting to note that in this species the

surface of the right valve is marked in a manner similar to the sculpturing of the left, a fact which is unusual in both the Aviculopectens and the Deltopectens.

Localities and horizon.—New South Wales: Conjola; Wyro, near Ulladulla; coast line between St. George's Basin and Ulladulla; Ulladulla; Burrier near Ulladulla (Laseron). Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of holotype and figured specimens.—F.19166 (holotype); F.19629 (pl. iv, fig. 2); F.19419 (pl. iv, figs. 3 and 5); F.19420 (pl. iv, fig. 4).

AVICULOPECTEN PARKESI, *sp. nov.*

(Plate v, figs. 1-3.)

Description.—The shell is orbicular, inequilateral, and both valves are equally and strongly convex. The hinge line is straight and is equal to the greatest width of the shell. The beak is pointed and prominent and slightly overhangs the hinge line. Anterior and posterior slopes converge to the umbo; the former is longer than the latter, which stops short on the lateral margin of the valve much higher than the anterior, which persists almost down to the ventral margin. This structure, together with the fact that the beak is posterior in position, causes the species to exhibit an obliquity. The antero-lateral portion of the umbonal area consists of a flattened area of considerable width. The ears are uneven, the anterior ear being the larger of the two, and separated from the body of the valve by a very distinct and deep byssal sinus. They are triangular in shape, and the outer margins in both are rounded. The anterior ear possesses a depression, which is almost median in position and separates the auricle into two portions.

The sculpture of this species is almost indistinguishable. It consists of very fine costæ, which radiate out from the umbo, and heavy concentric growth lines. The costæ are very numerous and do not increase in size, being the same at the ventral margin as in the umbonal region. The growth lines are numerous and at even distances from one another become exceptionally heavy. The auricles do not possess any distinctive sculpture, only slight traces of growth lamellæ being present.

The dimensions of the holotype and paratypes are approximately as follows:

	Pl. v, fig. 2. (Holotype.)	Pl. v, fig. 1. (Paratype.)	Pl. v, fig. 3. (Paratype.)
Height	48 mm.	48 mm.	46 mm.
Width	47 mm.	46 mm.	42 mm.
Dorsal margin ..	36 mm.	30 mm.	26 mm.

Observations.—This species is represented by a number of exceptionally well preserved specimens of both the right and the left valves. It is quite distinct from any other Palæopecten known to me, both by virtue of the extreme convexity of both valves and lack of distinct ornamentation. The species which it most closely resembles is *A. englehardti,* which, however, does not possess the strong convexity of the valves and the exaggerated length of the anterior slope. This species is named in honour of Mr. Varney Parkes, whose zealous and untiring collecting in the field made this work possible.

Localities and horizon.—New South Wales: Wyro, near Ulladulla; North Head, Ulladulla; coast line between St. George's Basin and Ulladulla; Gerringong. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of holotype and paratypes.—F.19472 (pl. v, fig. 1) (holotype), F.19567 (pl. v, fig. 2), F.19494 (pl. v, fig. 3).

AVICULOPECTEN ENGLEHARDTI, *Eth. and Dun.*

(Plate vi, figures 2 and 3.)

Aviculopecten elongatus De Koninck (*non* McCoy), Rech. Foss. Pal. Nouv-Galles du Sud, 3, 1877, p. 155, pl. 22, f. 5; (*transl.* David and Dun in Geol. Surv. of N.S.W., Mem. Pal., 6, 1898, p. 231, pl. xxii, fig. 5).

Aviculopecten englehardti Eth. Jun. and Dun, Mon. of the Carb. and Permo-Carb. Invert. of N.S.W., Mem. Geol. Survey of N.S.W., Palæontology, No. 5, ii, 1, 1906, p. 17 and figures.

Observations.—I have a number of excellently preserved specimens of this species from the Upper Marine Series collected from various localities. According to the localities given by Etheridge and Dun this species is characteristic both of the Upper Marine and Lower Marine Series. I have figured several of the better specimens for reference and give a list of the localities from which they were collected.

The dimensions of several fairly complete specimens are approximately as follows:

	Fig. 2.	Fig. 4.
Height	39 mm.	53 mm.
Width	35 mm.	52 mm.
Dorsal margin	22 mm.	35 mm.

Localities and horizon.—New South Wales: Tullawalla Point, St. George's Basin; Kangaroo Point, St. George's Basin; Wyro, near Ulladulla. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

AVICULOPECTEN MITCHELLI *Eth. and Dun.*

Aviculopecten mitchelli Etheridge, Jr., and Dun, Mem. Geol. Survey of N.S.W., Palæontology, No. 5, ii, 1, 1906, p. 11 and figures.

Observations.—This comparatively rare species of *Aviculopecten* is not represented in the Varney Parkes collection, for up to the present it has been found only in the Lower Marine Series. One of Etheridge and Dun's type specimens figured in their Monograph on plate i, figure 3, is before me, and I have taken this opportunity of publishing the dimensions, which has not yet been done.

Height	107 mm.
Width	85 mm.

Anterior auricle to beak 35 mm. (posterior auricle missing). Convexity of right valve 35 mm.

Locality and horizon.—New South Wales: Allandale, Maitland district. Permo-Carboniferous, Lower Marine Series.

Collection.—The Mining and Geological Museum, Sydney.

DELTOPECTEN MEDIA (*Laseron*).

(Plate vii.)

Aviculopecten media Laseron (pt.) Journ. Roy. Soc. of N.S.W., xliv, 1910, pp. 203-4, pl. xv, fig. 1.

Observations.—There is a large number of beautifully preserved specimens of this species in the collection, including both right and left valves.

This species was originally described and figured by Laseron from two specimens collected from the Wandrawandian Series of Burrier, New South Wales. They were an imperfect right valve with a well preserved auricle, and a nearly perfect cast of the united valves. The latter as already mentioned in this paper has been placed in *Aviculopecten gracilis.* The former specimen, an imperfect right valve, I have been able to determine as belonging to the genus *Deltopecten,* for in many of the specimens before me a small but distinct chondrophore is present.

From the series of specimens I possess many additional particulars have been gained to add to the original description, as well as further measurements, figures, and localities.

Description.—The shell is of medium size, slightly wider than high and with both valves convex, but not strongly so.

The left valve convex and flattened towards the ventral margin. Without the ears the valve would be equilateral. Hinge line straight, linear, grooved with resilium furrows and possessing a chondrophore of comparatively small size. Dorsal margin not as wide as the greatest width of the shell. Umbonal region flattened, with anterior and posterior slopes converging to form the beak, which is pointed, distinct, and slightly overhangs the hinge margin. The ventral margin of the shell is rounded and extensive, giving a fan-shaped appearance. The auricles are characteristically uneven in size and shape. The anterior auricle is extraordinarily large for the size of the valve, and is rectangular to triangular in shape, with a rounded outer margin. The posterior auricle is very small, triangular in shape and also possesses a rounded outer margin. The anterior auricle is separated from the body of the valve by an exceptionally deep byssal sinus, the posterior by only a slight depression.

The sculpture of the valve consists of radiating primary costæ. These are fine and slender in the umbonal region but in the later stages of the shell, towards the ventral margin, become heavy, broad, and rounded on top. They are twenty-four to twenty-six in number, are never bifurcated or interpolated with subsidiary costæ, and are separated from one another by broad and smooth valleys or intercostal spaces. The ornamentation on the ears is indistinct. The anterior ear possesses some six to eight primary costæ, while the posterior ear shows no ornamentation. Growth lines or lamellæ are characteristically absent both on the valves and on the ears.

The right valve is not quite so convex as the left, but in all other respects is very similar.

The dimensions of several of the figured specimens are approximately as follows:

	Fig. 1.	Fig. 4.	Fig. 5.
Height	78 mm.	94 mm.	82 mm.
Width	80 mm.	94 mm.	62 mm.
Dorsal margin	65 mm.	59 mm.	61 mm.
Anterior auricle (from chondrophore)	46 mm.	45 mm.	39 mm.
Posterior auricle (from chondrophore)	19 mm.	14 mm.	22 mm.

Relations and differences.—Laseron pointed out in his paper that this species undoubtedly approached very closely to *Aviculopecten profundus* De Kon. but summarized the differences as follows:

(1) The number of costæ in *A. media* is only about 25, instead of 40 as in *A. profundus*.

(2) In *A. profundus* the radii are crossed by numerous growth lines, producing a cancellated surface. The surfaces of the radii in *A. media* are quite smooth.

(3) The hinge line of *A. media* is slightly shorter than the greatest width of the shell, that of *A. profundus* is broader.

There is certainly a distinct likeness between these two species, but the above differences together with the fact that this species possesses a chondrophore, places it without doubt in the genus *Deltopecten,* thus making the separation complete. The extreme convexity of *A. profundus* also causes it to differ from Laseron's species.

It is noteworthy that the general outline of this species, together with the type of sculpture on the valves, shows only a very slight modification from several valve fragments of *Deltopecten illawarrensis* Morris, sp. (?) which are in the Australian Museum Collection.

This latter species has, however, up to the present been regarded as characteristic of the Lower Marine Series and has been collected at Allandale, in the Maitland district, New South Wales, and at the Mount Britton Gold Field, Queensland, in the Middle or Marine Series of the Bowen River Coal Field.

The main points of difference between these two species may be summarized as follows:

(1) In *D. media* the umbonal region is flattened and the valve itself is more flattened than in *D. illawarrensis.*

(2) The valve of *D. media* is as wide as or wider than high, instead of higher than wide as is usually the case in *D. illawarrensis.*

Further specimens from other localities may prove these species to be identical, as the above differences could possibly be caused by pressure and slight distortion.

Localities and horizon.—New South Wales: Coast line between St. George's Basin and Ulladulla; Wyro, near Ulladulla; Warden Head, Ulladulla; Wandrawandian; Mount Vincent (old collection); Burrier (Laseron).

Collection.—The Australian Museum, Sydney.

Registered numbers of figured specimens.—Pl. vii, fig. 1 (F.19090); pl. vii, fig. 2 (F.19618); pl. vii, fig. 3 (F.20169, Laseron's type); pl. vii, fig. 4 (F.19147); pl. vii, fig. 5 (F.19504).

DELTOPECTEN FITTONI (*Morris*).

(Plate viii.)

Pecten fittoni Morris, Strzelecki's Phy. Desc. N.S.W. etc., 1845, p. 277, pl. 14, f. 2.

Deltopecten fittoni, Etheridge, Jr., and Dun, Mem. Geol. Survey of N.S.W., Palæontology, No. 5, ii, 1, 1906, p. 30 and figures.

Observations.—This species is represented by some twenty exceptionally well preserved specimens from various localities in the Illawarra district; unfortunately they are all right valves. They in no way differ from previous descriptions, the costæ ranging from fifteen to twenty-five in number, all widely separated from one another by broad intercostal spaces. These valleys or intercostal spaces, together with the costæ are traversed by numerous fine radii or costæ, giving the valve a very characteristic appearance and at once separating it from all other Australian Palæopectens. Two specimens are figured, one an internal cast which shows a slight obliquity, and an impression which shows the sculpture to advantage.

The dimensions of the figured specimens are approximately as follows. The dimensions of the largest specimen in the collection are also given.

	Fig. 1.	Fig. 2.	Largest Specimen.
Height	78 mm.	83 mm.	150 mm.
Width	76 mm.	85 mm.	95 mm.
Dorsal margin ..	50 mm.	60 mm.	120 mm.

Localities and horizon.—New South Wales: Conjola; Warden Head, Ulladulla; coast line between St. George's Basin and Ulladulla; Ulladulla. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of figured specimens.—Pl. viii, fig. 1 (F.19438); pl. viii, fig. 2 (F.19146).

DELTOPECTEN DEPRESSUS, *sp. nov.*

(Plate ix, and plate x, figures 1 and 2.)

Description.—The shell is of large size, concavo-convex, and, with the auricles excluded, is equilateral. Shell thin, the general outline subcircular, and as wide as high, or in some cases slightly higher than wide. The largest specimen is 195 mm. high.

The left valve is gently convex, becoming slightly flattened towards the ventral margin. The dorsal margin is not nearly as wide as the greatest width of the valve. The anterior and posterior

slopes are short, very much depressed, and converge to form a blunt and flattened umbo. The beak slightly overhangs the hinge margin and is median in position. The anterior and posterior auricles are similar in size and shape. They are both triangular, with straight outer margins. The former is separated from the body of the valve by a slight depression, but the junction of the latter with the valve is indistinguishable. The hinge area is exceedingly broad, particularly beneath the umbones, where it is excavated into a large and rounded rectangular chondrophore pit, which narrows towards the anterior and posterior extremities.

The ornamentation of the valve consists of primary, secondary, and tertiary costæ with concentric growth lines. The primary costæ are about twenty in number, originating in the umbonal region and spreading out in fan-like manner to the ventral margin. In the younger specimens these costæ are more or less slender with sharp tops, but in the larger specimens they have become heavier and more swollen and rounded on top. They are separated from one another by broad and smooth valleys or intercostal spaces. Along the centre of each intercostal space a secondary costa is found, and between these and each primary at least one and sometimes two tertiary costæ occur. These are very fine and in some specimens are indistinguishable. Concentric growth lines are present but are not conspicuous. Ornamentation on the ears is absent, except for growth lines.

The right valve is concave, more or less flattened in the umbonal region and strongly concave at the ventral margin. The ears are similar to those of the left valve, but the sculpture differs in that only primary costæ are found. These are exceptionally heavy, about twenty in number, and separated by broad valleys or intercostal spaces.

The dimensions of several of the figured specimens as well as the holotype are approximately as follows:

	Pl. ix, fig. 1.	Pl. x, fig. 1.
Height	195 mm.	180 mm.
Width	167 mm.	173 mm.
Dorsal margin	111 mm.	115 mm.

Chondrophore pit (pl. ix, fig. 2).—Width 30 mm., height 15 mm.

Observations.—This species is represented by several fairly well preserved specimens, some of which are complete shells, consisting of both right and left valves. Among the Deltopectens there is nothing to my knowledge which in any way compares with this almost gigantic form of Palæopecten. The specimens can almost be divided into two series by their sculpture; in one series, which I consider are immature shells, the sculpture is composed of fine costæ, whereas in the adult forms the costæ become thickened and

strong. The series of specimens which I have examined shows almost a graded variation from the adult to the immature, so that separation under these circumstances is impossible. In the Taiyuan Series of North China a new species of *Deltopecten* has been described quite recently by Yatseng T. Chao, Geologist to the Geological Survey of China.[7] This species, *Deltopecten giganteus*, has many points in common with my species, but a glance at the figures proves that they could not be placed together. The main points of difference are in the costæ and they may be summarized as follows:

(1) In *D. giganteus* the primary and secondary costæ are numerous, and closely packed together. In *D. depressus* the primary costæ are much larger and more rounded and are separated by intercostal spaces of considerable width. The secondary costæ are also much more slender than in *D. giganteus*.

(2) In *D. giganteus* the anterior ear is distinct and is separated from the body of the valve by a distinct and deep byssal sinus, whereas in *D. depressus* the ears are not distinctly marked off, the valve practically merging into the ears.

Locality and horizon.—Kioloa, near Ulladulla, New South Wales. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of holotype and figured specimens.—Plate ix, fig. 1 (F.19098); plate ix, fig. 2 (F.19532); plate x, fig. 1 (F.19193); plate x, fig. 2 (F.19485).

DELTOPECTEN *cf.* GIGANTEUS *Chao.*

(Plate xi.)

Deltopecten giganteus Chao, Geol. Survey, China, (B), ix, 3, pp. 36-37, pl. iii, figs. 1-3; pl. iv, figs. 1-3.

Observations.—In the Varney Parkes collection there is a portion of a specimen which corresponds perfectly with the description of this species and also agrees with the figures. It consists of the dorsal portion of a complete specimen, and shows therefore the dorsal halves of both valves as well as the hinge area and the chondrophore. The description of the specimen which I have examined is as follows:

The shell if it were complete would be of large size and as wide as high. The shell itself is thin and fragile.

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[7] Chao.—*Loc. cit.*, p. 36-37, pl. iii, figs. 1-3, pl. iv, figs. 1-3.

The left valve is strongly convex, particularly in the umbonal region. The dorsal margin is not nearly as wide as the greatest width of the valve. The anterior and posterior slopes are depressed and converge to form the umbo, which is itself depressed and pointed. It slightly overhangs the hinge margin. The hinge area is broad, and under the umbones is excavated into a chondrophore pit which is fairly large. The hinge area is linear, marked by numerous fine horizontal striations. The ears on the left valve are absent.

The sculpture consists of primary and secondary costæ. The former are about twenty-five to thirty in number and are heavy and wide. They vary in size, some being almost twice as thick and prominent as others. In the umbonal region they are uniform in thickness and the secondary costæ are absent. These are much smaller than the primary, and appear to originate a considerable distance from the umbo. They occur interpolated between the primary costæ. Intercostal spaces are small and acute, giving the costæ an appearance of being closely packed together. Concentric growth lines are present and numerous, and, as pointed out by Chao, "are regular and continuous in the early stages of the shell, becoming later on more distant and at the same time confined mainly to the tops of the radiating plications where they rise as scale-like projections."

The right valve is more or less flattened except in the umbonal region, where the shell is considerably swollen. The beak is insignificant and terminates in a median position on the margin. The anterior ear is triangular in shape with a rounded outer margin. It is separated from the body of the valve by a distinct byssal sinus. The posterior ear unfortunately is missing.

The sculpture on this valve, however, is slightly different from that of the left valve. It consists of primary and secondary costæ, but the former are more numerous, some thirty to thirty-five being present. The secondary on the other hand only occasionally occur interpolated between the primary costæ. Intercostal spaces are wider and more concave than on the left valve. The ornamentation on the ears is similar to that of the valve.

Locality and horizon.—Kioloa, near Ulladulla, New South Wales. Permo-Carboniferous, Upper Marine Series.

The dimensions of this specimen are given; from these the large size of the shell may be imagined.

	Pl. xi, fig. 2.
Height of fragment	103 mm.
Width of fragment	160 mm.
Dorsal margin	80 mm. ?

Collection.—The Australian Museum, Sydney.

Registered number of figured specimen is F.19451.

DELTOPECTEN LENIUSCULUS *Dana*.

(Plate xii, and figures 3-4.)

Pecten leniusculus Dana, Am. Journ. Sci., 1847, (2), iv, p. 160.

Pecten leniusculus Dana, Wilkes U.S. Explor. Exped., 1849, x (Geol.), p. 704, atlas, pl. ix, fig. 6 *a* and *b*.

Deltopecten leniusculus (Dana), Etheridge, Jr., and Dun, Mon. of the Carb. and Permo-Carb. Invert. of N.S.W., Mem. Geol. Survey of N.S.W., Palæontology, No. 5, ii, 1, 1906, p. 28 and figures.

Deltopecten rienitsi Mitchell, Proc. Roy. Soc. N.S.W., lii, 2, 1927, p. 104, pl. ii, figs. 1 and 2.

Observations.—Dana's original description of this species was comparatively brief, but further details have been added by Etheridge and Dun. This species is represented by at least some sixty or seventy specimens, including very well preserved specimens of both valves. In the synonomy of this species I have placed Mitchell's *Deltopecten rienitsi*. This specimen from which the species was founded is, I consider, a distorted form of *D. leniusculus*. It appears to have been very abundant in our Upper Marine Series. Several of the better preserved specimens have been figured, and the dimensions and localities are also given.

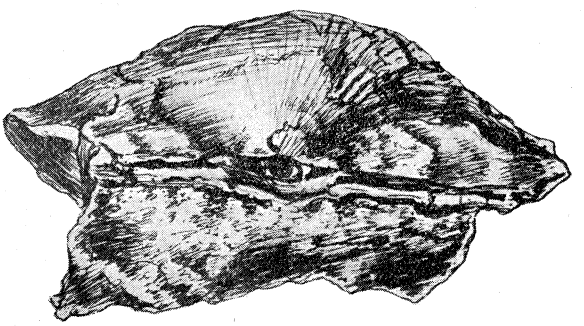


Figure 3.

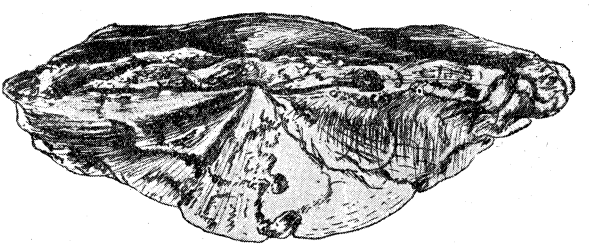


Figure 4.

The dimensions of several of the figured specimens are approximately as follows:

	Pl. xii, fig. 1.	Pl. xii, fig. 2.	Pl. xii, fig. 3.
Height	85 mm.	68 mm.	122 mm.
Width	87 mm.	68 mm.	122 mm.
Dorsal margin ..	63 mm.	59 mm.	80 mm.

Localities and horizon.—New South Wales: Warden Head, Ulladulla; coast line between St. George's Basin and Ulladulla; North Head, Ulladulla; Bundanoon Gully; Wyro, near Ulladulla; Wollongong and Conjola. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of figured specimens.—Pl. xii, fig. 1 (F.19407); pl. xii, fig. 2 (F.19415); pl. xii, fig. 3 (F.19634); pl. xii, fig. 4 (F.19548); pl. xii, fig. 5 (ptn. of F.19605).

Deltopecten comptus (*Dana*).

(Plate xiii, figures 1-4.)

Pecten comptus Dana (*non* McCoy), Am. Journ. Sci. (2), iv, 1847, p. 160.

Deltopecten subquinquelineatus Etheridge, Jr., and Dun, Mem. Geol. Survey of N.S.W. Palæontology, no. 5, ii, 1, 1906, p. 26.

Observations.—Dana's species, *Pecten comptus,* was placed by Etheridge and Dun in the synonymy of *D. subquinquelineatus,* as it was thought by these authors to be identical with that species. There has, however, since come to hand in the collection I am now dealing with several excellently preserved specimens which differ from the typical *D. subquinquelineatus* but which I am able to associate with Dana's type. This is a definite coarsely ribbed form, and so unlike *D. subquinquelineatus* that I have no hesitation in re-establishing Dana's species. As the volume in which his original description appears is by no means common, I reproduce it here.

"*Pecten comptus* (Dana).—Orbicular, 20-22 larger costæ, obtusely triangular, with the sulci broadly concave, and occupied with a medial costa, and 1 to 3 smaller; costæ naked, without markings or transverse striae. Ears large, longitudinally marked with fine diverging costæ. Length and height, $2\frac{1}{3}$ inches; distance, at the lower margin, between the middle of two larger costæ, to nearly $\frac{1}{4}$ inch. Plate 9, fig. 5, natural size.

"Harper's Hill.

"The specimen is a single convex valve. The shell is white and well preserved, and is less than a third of a line thick."

The specimen mentioned by Dana as being figured on plate 9, fig. 5, is his type specimen. The cast of this has been refigured in this paper on plate xiii, fig. 3.

Additional details gained from the series of specimens in the collection are as follows.

This species is represented by specimens of what I take to be both valves, some being convex while others are considerably flattened. The ears are absent on the flattened or right valves.

Left valve is strongly convex, as wide as high and with a subcircular outline. The dorsal margin is not as wide as the valve below. Anterior and posterior slopes rapidly converge to form the beak, which is pointed and prominent and overhangs the hinge line. Umbonal margins are curved and reach the lateral margins about midway down the shell. Ventral margin rounded, giving the shell a somewhat fan-shaped appearance. The auricles are uneven, the anterior ear being smaller than the posterior ear. The former is rectangular in shape with a rounded outer margin. The posterior ear is broadly triangular and also possesses a rounded outer margin. A byssal sinus separates the anterior ear from the body of the valve, while the posterior ear is marked off only by a shallow depression.

The sculpture is essentially the same on all the specimens, and consists of primary, secondary and tertiary costæ. Concentric growth lines are present. The primary costæ are twenty to twenty-five in number, originating at the apex of the umbo and radiating out to the ventral margin. These are slender in the umbonal region but in the later stages of the shell, towards the ventral margin, become considerably thickened and coarse. The secondary costæ occur interpolated between the primaries, arising near the base of the umbo and extending to the ventral margin. Between each primary and secondary costa a single or occasionally two tertiary costæ occur. The auricles are ornamented in much the same manner as the valves. The anterior ear is ornamented with six primary costæ with intercalated secondaries, but on the posterior ear primary costæ are lacking, the ear being covered with fine costæ. Heavy growth lines occur at regular intervals, both on the body of the valve and on the auricles, denoting no doubt growth stages of the shell.

The right valve is flattened considerably, but in other respects is similar to the left valve.

The dimensions of several of the figured specimens are approximately as follows:

	Fig. 2.	Cast of Dana's Type. Fig. 3.
Height	66 mm.	56 mm.
Width	62 mm.	62 mm.
Dorsal margin	56 mm.	38 mm.

Relations and differences.—By virtue of its large and coarse primary costæ this species resembles *D. fittoni,* but differs in the number and character of the secondary and tertiary costæ as well as in its small size. Its ornamentation also definitely separates it from *D. subquinquelineatus.*

Localities and horizon.—New South Wales: Illawarra (cast of Dana't type); Tianjarra, Wandrawandian Creek, South Coast; North Head, Ulladulla; Upper Burragorang Valley near the Oaks, 7 miles from Nattai River (W. H. Glover); Lake Tullawalla, St. George's Basin. Permo-Carboniferous, Upper Marine Series.

Western Australia: Low Hill, loc. m. 308, 17 miles east of Minginew (Carb.? A. Gibb Maitland).

Registered numbers of figured specimens.—Pl. xiii, fig. 1 (F.19427), pl. xiii, fig. 2 (F.19523), pl. xiii, fig. 3 (cast of Dana's type L.683), fig. 4, micro-photograph (F.19427).

Collection.—The Australian Museum, Sydney.

Deltopecten farleyensis *Eth., Jr., and Dun.*

(Plate vi, figs. 1-3.)

Deltopecten farleyensis Etheridge, Jr., and Dun, Mem. Geol. Survey of N.S.W., Palæontology, No. 5, ii, 1, 1906, p. 29 and figures.

Observations.—Etheridge and Dun remarked in their observations that there was a general similarity between *D. farleyensis* and *D. leniusculus,* in that the ornamentation was practically identical, but the former differed by its fan-shaped outline and great length of its dorsal margin. On looking over several of their figures of *D. farleyensis,* the similarity in form to *D. leniusculus,* led me to re-examine critically the specimens, which resulted in the following conclusions. The specimens figured on plate xvi, figure 4, plate vi, figure 2, and plate xiii, figure 5, are undoubtedly the right valves of *D. leniusculus* and not *D. farleyensis.* The remaining figured specimens together with an internal cast and complete specimen with united valves in the Australian Museum collection are to my knowledge the only known specimens of this species. It is interesting to note that the specimens which have recently come to hand have been collected from the Upper Marine Series of the Illawarra district. Mr. Varney Parkes collected one at Ulladulla, while the other was collected some years ago at Jamberoo. This definitely places on record the fact that *D. farleyensis* occurs both in the Lower and Upper Marine Series of the Permo-Carboniferous. All Etheridge and Dun's specimens were collected from the Lower Marine Series.

These constitute a distinct and satisfactory group, from which the following details have been derived, and which are published as an addition to the original description.

Description.—In general outline the valves are subcircular, as high as wide, and both valves are more or less flattened. The shell itself is thin and fragile and as a result the majority of specimens are internal casts showing no ornamentation.

The left valve is gently convex, swollen in the umbonal region, and flattening out towards the ventral margin, which is rounded. The anterior and posterior slopes are depressed and converge widely to form a comparatively broad umbo, which slightly overhangs the hinge margin. Umbo is median in position. The hinge area is broad and is coarsely striated or grooved. Beneath the umbones an excavation or chondrophore pit is formed. The dorsal margin is exceptionally long and straight, and is a third as long again as the valve below, both in width and height. The ears differ in size and shape. The anterior ear is triangular in shape with the outer edge rounded, and is separated from the body of the valve by a comparatively deep and broad byssal sinus. The posterior ear is alate, with a straight outer edge. The posterior dorsal angle is pointed.

The ornamentation consists of numerous closely packed primary costæ with occasional intercalated secondary costæ. The former are slender and sharp, and apparently retain the same width on the ventral margin as on the umbonal region. The same type of sculpture is carried on to the auricles, where concentric growth lines also occur.

The right valve is flattened, slightly swollen in the umbonal region, becoming slightly concave at the ventral margin. The sculpture consists of a large number of radiating primary costæ, which are, however, separated from one another by broad and smooth intercostal spaces. The costæ are fine and delicate. The beak is insignificant and does not extend beyond the hinge margin.

The dimensions of a small specimen figured in Etheridge and Dun's monograph in plate xxiii, figure 6, and a large specimen figured in plate vi, figure 1 in this paper, are approximately as follows:

	Small Specimen.	Large Specimen.
Height	24 mm.	79 mm.
Width	24 mm.	80 mm.
Dorsal margin	38 mm.	103 mm.

Relations and differences.—As mentioned earlier this species has a slight resemblance to *D. leniusculus,* but a glance at the dimensions of both species proves that they must undoubtedly be disassociated from one another. The extraordinary length of the dorsal margin of this species makes it an outstanding type, as no other species of *Deltopecten,* to my knowledge, could be compared with it.

Localities and horizons.—New South Wales: Jamberoo (J. R. Lievers); Ulladulla. Permo-Carboniferous, Upper and Lower Marine Series.

Collection.—The Australian Museum, Sydney.

Registered number of figured specimen, F.16895.

DELTOPECTEN LIMÆFORMIS (*Morris*).

(Figure 5.)

Pecten limæformis Morris, Strzelecki's Phys. Descrip. of N. S. Wales, etc., 1845, p. 277, plate xiii, fig. 1.

Deltopecten limæformis (Morris), Etheridge, Jr., and Dun, Mem. Geol. Survey of N.S.W., Palæontology, No. 5, ii, 1, p. 22 and figures.

Observations.—This species is represented by only one imperfect specimen collected from the Lower Marine Series at Harper's Hill in the Maitland district. This specimen shows the ornamentation to advantage, but otherwise is lacking in distinct characters. The dimensions of two specimens, one figured in Etheridge and Dun's monograph on plate xi, figures 1 and 2, and a specimen in the

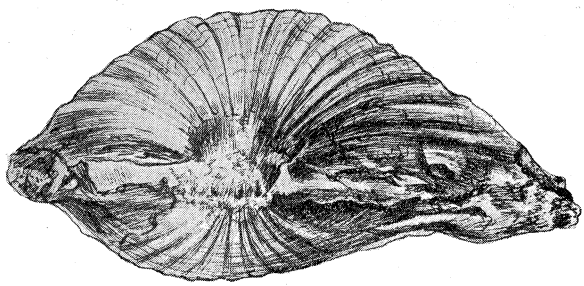


Figure 5.

Museum collection, are approximately as follows:

	Figured Specimen.	Museum Specimen F.10866.
Height	160 mm.	135 mm.
Width	141 mm.	140 mm.
Dorsal margin	—	80 mm. ?
Convexity of both valves in umbonal region ..	50 mm.	50 mm.

Collection.—The Australian Museum, Sydney.

Deltopecten clarkei, *sp. nov.*

(Plate xiv, and figure 6.)

Description.—This species is represented by several internal casts of united valves, and in each specimen the ears are missing. The shell is circular in outline and is as high as wide, or slightly higher than wide.

The left valve is convex, being swollen at the umbonal region and becoming flattened towards the margins. The anterior, posterior, and ventral margins rounded. The anterior and posterior slopes short and depressed, diverging widely from the umbo. Umbo pointed and prominent, overhanging the hinge margin. The evidence left by the ears points to the anterior being the larger of the two. It was separated from the valve by a distinct and acute byssal sinus. The posterior ear merged almost imperceptibly into the valve. A distinct chondrophore is present on the hinge area.

The ornamentation is absent on all my specimens.

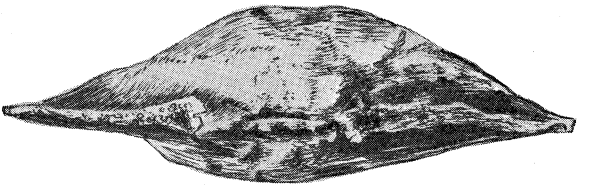


Figure 6.

The right valve is flattened, being only slightly swollen at the umbo. The umbo itself is insignificant and blunt and does not extend to the hinge margin. In all other respects it is similar to the left valve. The sculpture on this valve is shown and consists of primary costæ. These are about forty in number, angular in shape and fine and slender. They are separated by broad and smooth valleys or intercostal spaces.

The dimensions of the holotype and paratype are approximately as follows:

	Holotype. Pl. xiv, fig. 1.	F.10861.	Paratype. Pl. xiv, fig. 2.
Height	116 mm.	122 mm.	96 mm.
Width	109 mm.	111 mm.	103 mm.
Dorsal margin	—	60 mm. ?	50 mm. ?
Convexity of both valves at umbo ..	26 mm.	26 mm.	30 mm.

Observations.—In plate x, figure 3, Etheridge and Dun in their monograph figured a specimen which they called an internal cast of the united valves of *D. limæformis*. Additional specimens that have come to hand prove, however, without any doubt that this specimen must be placed with *D. clarkei*. The dimensions of this specimen are given in the middle column of the above measurements.

This species resembles *D. limæformis* to a certain extent, but the chief points of difference may be summed up as follows:

(1) In *D. clarkei* the right valve is practically flat, whereas in *D. limæformis* both valves are strongly convex.

(2) The umbo of the left valve of *D. clarkei* is long and overhangs the hinge margin. The umbo of the right valve does not extend to the hinge margin. In *D. limæformis* the umbones are practically equal and do not overhang the hinge margin to any extent.

(3) The smaller size and absence of a distinct oblique depression on the posterior end of the valve is also a marked difference.

Localities and horizon.—New South Wales: Gerringong; Sussex Inlet; Bomaderry (F. Mitchell). Permo-Carboniferous, Upper Marine Series.

Registered numbers of holotype and paratype, Fig. 1 (F.19526), paratype (F.19524).

Collection.—The Australian Museum, Sydney.

Deltopecten, sp.

(Plate vi, figure 4.)

Included in the material collected by Mr. Varney Parkes is an internal cast of a Deltopecten which is a distinct type, and quite different from any other species of the above genus. For the purpose of identification I am publishing the figure, which is a cast of the right valve, and a description of the characters which may be ascertained from this cast. It is of interest in that it is one of the very few Deltopectens collected in the Wandrawandian Series at Tianjarra in the Illawarra district, New South Wales.

The right valve is strongly convex, oblique and asymmetrical, and produced somewhat posteriorly. The valve is much higher than wide and the dorsal margin is not as wide as the greatest width of the valve below. The anterior and posterior slopes are accentuated and diverge more or less sharply from the umbo, which is prominent and pointed and extends to the level of the hinge margin. The anterior and posterior slopes reach the margin of

the shell one-third the distance of the valve from the hinge line. This gives an extensive anterior, posterior, and ventral margin, which is semi-circular. The hinge area is broad and strong and beneath the umbones is excavated to form a chondrophore pit of large size allowing for different proportions. The anterior and posterior auricles are similar in size and form, the posterior auricle being perhaps slightly more convex than the former. A sinus is absent.

The ornamentation of the shell has not been preserved. The left valve apparently was also strongly convex with a prominent umbo which slightly overhung the hinge area.

The dimensions of this specimen are approximately as follows:

Height, 73 mm.; width, 61 mm.; dorsal margin, 40 mm.

Locality and horizon.—New South Wales: Tianjarra, Wandrawandian Creek gullies, South Coast. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered number of figured specimen, F.19428.

Deltopecten subquinquelineatus (*McCoy*).

(Plate xv.)

Pecten subquinquelineatus McCoy, Ann. Mag. Nat. Hist., 1847, xx, p. 398, pl. 17, f. 1.

Deltopecten subquinquelineatus (McCoy), Etheridge, Jr., and Dun, Mem. Geol., Survey of N.S.W. Palæontology, No. 5, ii, 1, 1906, pp. 26-28 and figures.

Observations.—This species is represented by a series of thirty or more exceptionally well preserved specimens from various localities in the Upper Marine Series of the South Coast district of New South Wales. They include both left and right valves and also complete specimens of united valves. All of these agree practically in every detail with the description already published of the typical *D. subquinquelineatus*.

Several of the more complete specimens are figured for reference, a left valve and two right valves which show to advantage the valve sculpture. A photo-micrograph of the ornamentation is also published, as well as further localities and the dimensions of the figured specimens.

The dimensions are approximately as follows:

	Fig. 2.	Fig. 3.	Fig. 4.
Height	68 mm.	48 mm.	43 mm.
Width	70 mm.	50 mm.	48 mm.
Dorsal margin ..	46 mm.	49 mm.	—

..*Localities and horizon.*—New South Wales: Gerringong; Wyro, near Ulladulla; Warden Head, Ulladulla; coast line between St. George's Basin and Ulladulla; Tullawalla Point, St. George's Basin. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of figured specimens.—Pl. xv, fig. 1 (portion of F.19387); pl. xv, fig. 2 (F.19522); pl. xv, fig. 3 (F.19449); pl. xv, fig. 4 (F.19387).

DELTOPECTEN SUBQUINQUELINEATUS, *var.* DELICATULA, *var. nov.*

(Plate xvi.)

Description.—The shell is of large size and is as wide as high. The general outline is sub-circular and without ears would be equilateral. The largest specimen is 108 mm.

The left valve is gently convex, somewhat fan-shaped in appearance, with a large ventral margin. The anterior and posterior slopes are steeply inclined and diverge from the umbo in a slight curve and meet the anterior and posterior margins about midway down the shell. The umbo is sharp and prominent and slightly overhangs the hinge area. The auricles differ in size and shape. The anterior auricle is smaller than the posterior, and has a straight outer margin. The posterior auricle has the outer margin rounded and is broadly triangular in outline. The former is separated from the valve below by a distinct byssal sinus. The hinge area is broad and striated. Chondrophore pit is situated below the umbones.

The sculpture of the valve consists of primary and secondary costæ, which radiate towards the ventral margin. The primary costæ are about thirty in number and originate at the apex of the umbo. In between these the secondary costæ are formed, as many as three or four being present, which gives the valve a closely packed costate appearance. Tertiary costæ are absent.

The right valve is considerably flattened, but in all other respects is practically identical with the left valve.

The dimensions of the holotype and the paratype are approximately as follows:

	Fig. 1. (Holotype.)	Fig. 2. (Paratype.)
Height	80 mm.	104 mm.
Width	78 mm.	114 mm.
Dorsal margin	70 mm.	78 mm.

Observations.—Etheridge and Dun have already pointed out that in *D. subquinquelineatus* great variation is exhibited in the sculpture and slightly in the general outline. The series of specimens from which the variety *D. subquinquelineatus* var. *delicatula* is made, exhibit the variation so constantly that I consider they merit at least varietal rank. The chief points by which they differ from the typical species are the absence of tertiary costæ and the great number of primary and secondary costæ. The general outline of this variety and its large size also makes it a distinct group. The concentric growth lines and lamellæ, so distinctly shown in the photo-micrograph is also a distinct character of the variety, although it is not so pronounced in all specimens.

Localities and horizon.—New South Wales: North Head, Ulladulla; Ulladulla; coast line between St. George's Basin and Ulladulla; Wandrawandian Creek; Gerringong. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of figured specimens.—Fig. 1 (F.19486, holotype); fig. 2 (paratype F.19092); fig. 3 (portion of F.19204).

Deltopecten lata, *sp. nov.*

(Plate v, figures 4 and 5.)

Description.—This species is represented by a number of exceptionally well preserved specimens of both right and left valves. The shell is scallop-shaped, equilateral (without ears) and equivalve. It is a small form, rarely exceeds 36 mm. in height, and is much wider than high.

The valves are strongly convex, with the anterior and posterior slopes curved and rapidly diverging from the umbo. The umbo is prominent and pointed and slightly overhangs the hinge margin. The auricles differ from one another in that the anterior ear margin is rounded. The shape is broadly triangular. The posterior ear is comparatively large, with a straight outer margin, and the postero-dorsal angle is pointed. The hinge line is straight, not nearly as wide as the greatest width of the valve. Beneath the umbones on the narrow hinge area a small excavation marks the chondrophore pit.

The sculpture consists of primary and secondary costæ. The former are twenty to twenty-five in number, originating at the apex of the umbo and radiating towards the ventral margin. They are fine and angular and are separated from one another by broad intercostal spaces. Along the centre of each intercostal space or valley a secondary costa is found. These are inferior in size to the primary and originate at the base of the umbonal region. The auricles are ornamented with costæ of one size and range from six to eight in number. The ornamentation is traversed by a close frill imbrication or growth lamellæ, which when passing over the primary rise into acute echinations, almost spines.

The dimensions of several specimens, including the holotype and the paratype, are approximately as follows:

	Holotype. Fig. 4.	Paratype. Fig. 5.	Paratype. F.19515.
Height	29 mm.	34 mm.	38 mm.
Width	35 mm.	47 mm.	47 mm.
Dorsal margin ..	24 mm.	28 mm.	31 mm.

Observations.—This is a particularly handsome little shell quite different from any other species of *Deltopecten*. It is similar in its ornamentation, and at first sight in shape, to *Aviculopecten sprenti*, the only other species of Palæopecten which it in any way resembles. The chief points of difference may be summed up as follows:

(1) *D. lata* possesses a chondrophore, which in *A. sprenti* is absent.

(2) In *D. lata* the shell is much wider than high, in *A. sprenti* as wide as high.

(3) In *A. sprenti* the dorsal margin is as wide as the greatest width of the body, in *D. lata* the dorsal margin is not nearly as wide as the valve.

Localities and horizon.—New South Wales: Maitland district; North Head, Ulladulla; coast line between St. George's Basin and Ulladulla. Permo-Carboniferous, Upper Marine Series.

Collection.—The Australian Museum, Sydney.

Registered numbers of holotype and paratype.—Pl. v, fig. 4 (holotype, F.19624); fig. 5 (paratype, F.19514); (paratype F.19515).

ACKNOWLEDGMENTS.

I have pleasure in acknowledging my indebtedness to Mr. W. S. Dun, Palæontologist to the Geological Survey and Lecturer

in Palæontology, University of Sydney, whose cordial assistance, advice and criticism have been of great value in the preparation of this paper. To Mr. G. C. Clutton my best thanks are due for the excellent photographs and photo-micrographs, and to Miss Joyce K. Allan I am deeply indebted for the drawings of the text-figures.

EXPLANATION OF PLATE I.

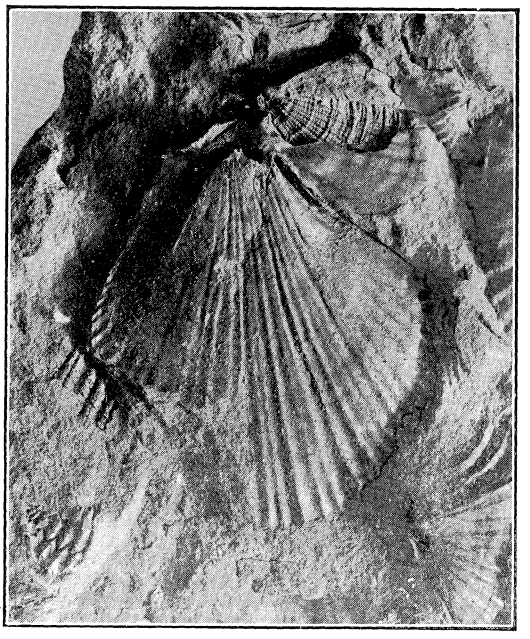
Aviculopecten extensus, sp. nov.

Headland, near Ulladulla, New South Wales.

Fig. 1. Internal cast of a right valve, showing portion of anterior ear sculpture of the left valve.

Fig. 2. Photo-micrograph of valve sculpture of Fig. 3, exhibiting primary costæ, with occasional intercalated secondary costæ.

Fig. 3. External impression of a right valve with a portion of the posterior ear missing. The sculpture on both the auricles and the body of the valve is seen to advantage.



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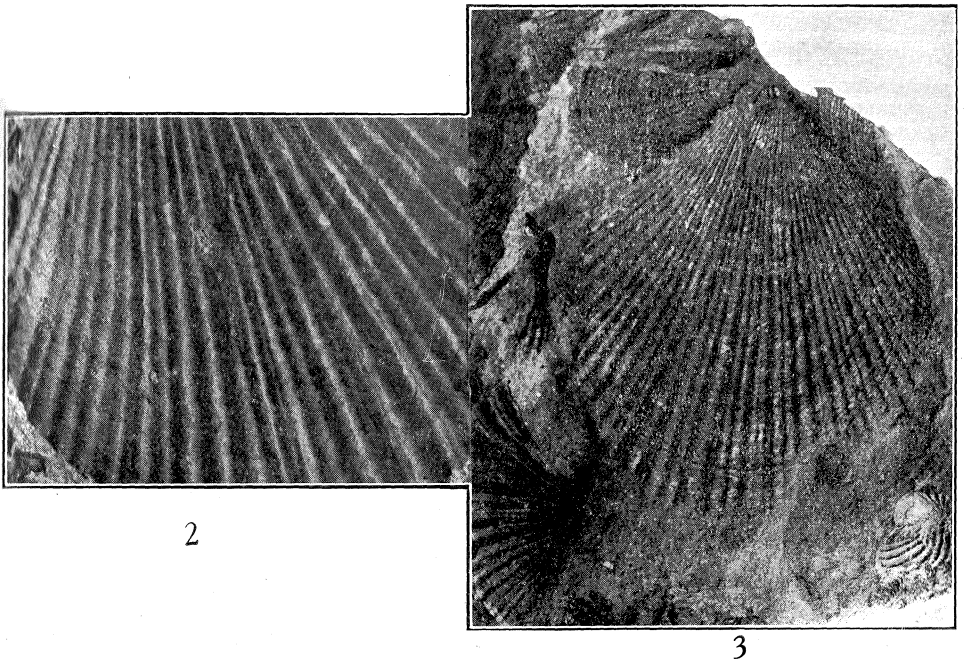

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G. C. Clutton, Photo.

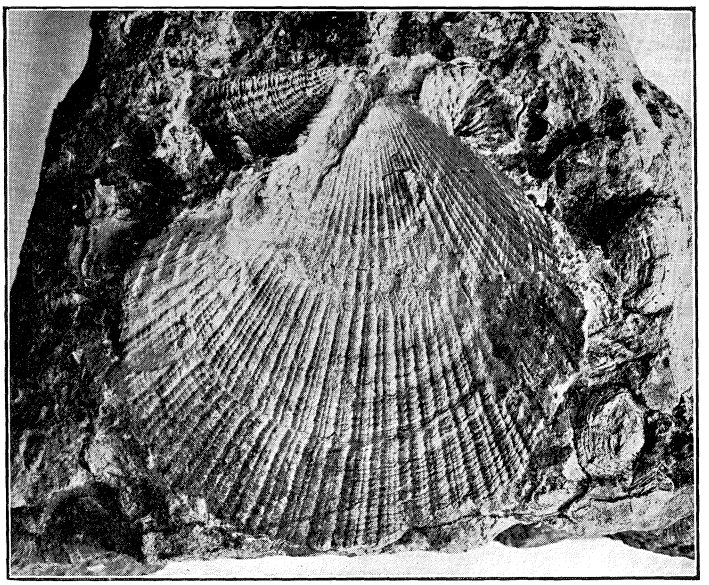
EXPLANATION OF PLATE II.

Aviculopecten multicostatus, sp. nov.

Fig. 1. External impression of a perfect right valve, exhibiting primary, secondary and tertiary costæ. The concentric growth lamellæ or frill imbrication is well defined on the body of the valve. St. George's Basin, New South Wales.

Fig. 2. A portion of a left valve of an immature specimen showing the ornamentation. Kangaroo Point, St. George's Basin, New South Wales.

Fig. 3. An external impression of a large left or convex valve with the posterior auricle missing. The byssal sinus separating the anterior auricle from the valve below is to be noted. Kangaroo Point, St. George's Basin, New South Wales.



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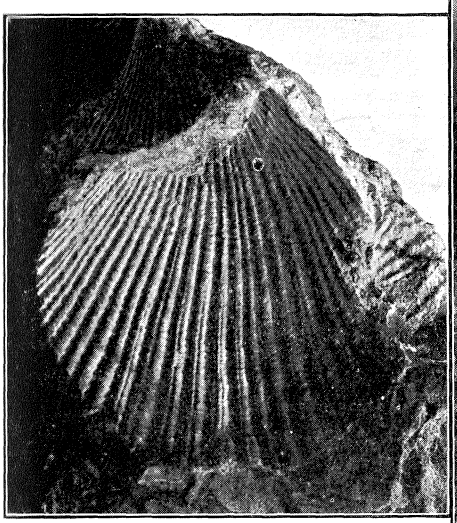

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G. C. Clutton, Photo.

EXPLANATION OF PLATE III.

Aviculopecten sprenti, Johnston.

Fig. 1. Portion of the left or convex valve showing posterior and anterior ears and the sharp pointed umbo. Gerringong, New South Wales.

Fig. 2. A photo-micrograph of the right or flat valve ornamentation. Note that the costæ are all the same type. Gerringong, New South Wales.

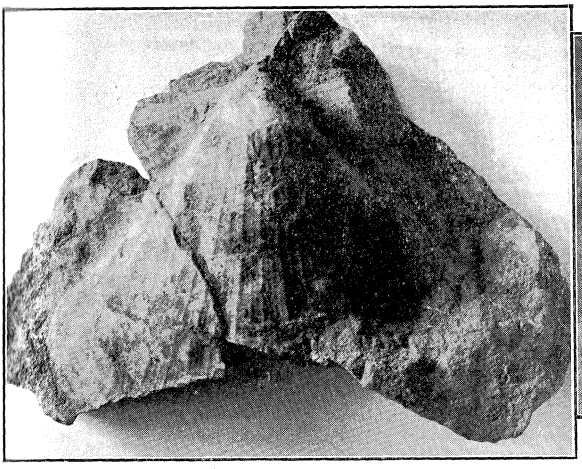
Fig. 3. A convex valve with both auricles missing but showing the convexity. Gerringong, New South Wales.

Fig. 4. The reverse of Fig. 3 exhibiting the right or flat valve and the beak of the left valve which slightly overhangs the hinge area.

Fig. 5. A left valve exhibiting valve sculpture. St. George's Basin, New South Wales.

Fig. 6. A perfectly preserved left valve, exhibiting the relative proportions of the auricles. Ulladulla, New South Wales.

Figs. 7, 8. Photo-micrographs of a portion of a left valve, showing the type of ornamentation. (*a*) Primary, (*b*) Secondary, (*c*) Tertiary. St. George's Basin, New South Wales.



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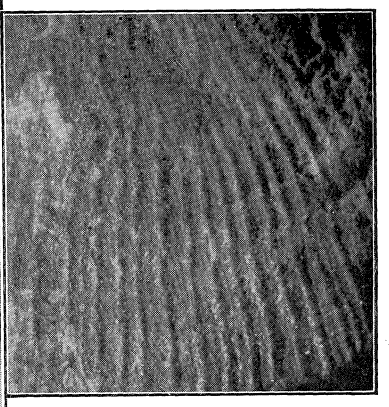

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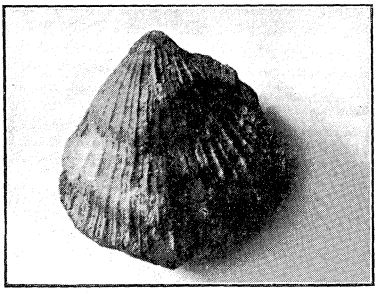

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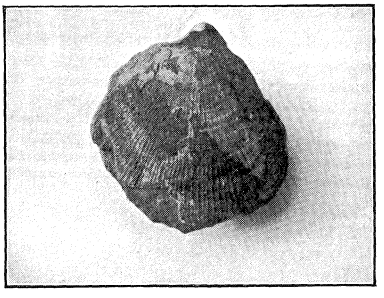

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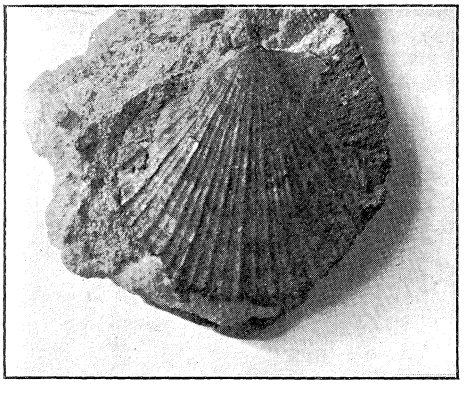

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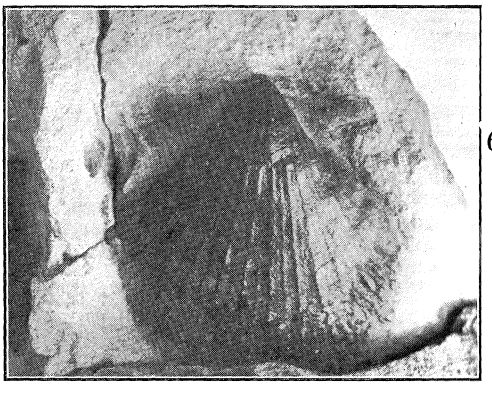

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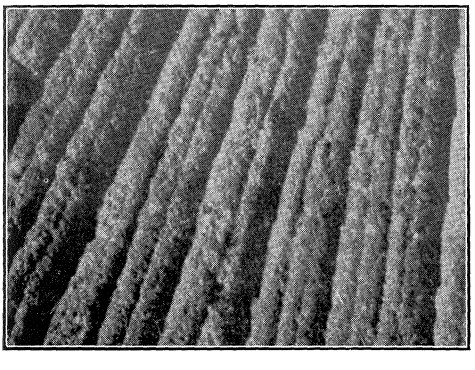

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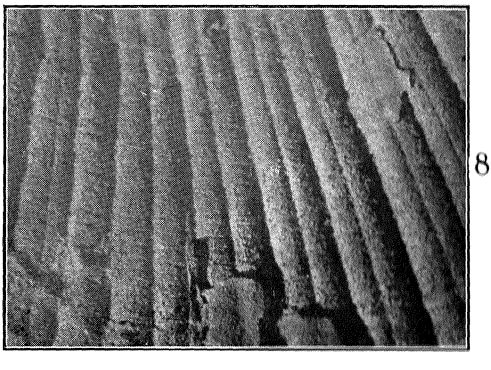

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G. C. Clutton, Photo.

EXPLANATION OF PLATE IV.

Aviculopecten gracilis, sp. nov.

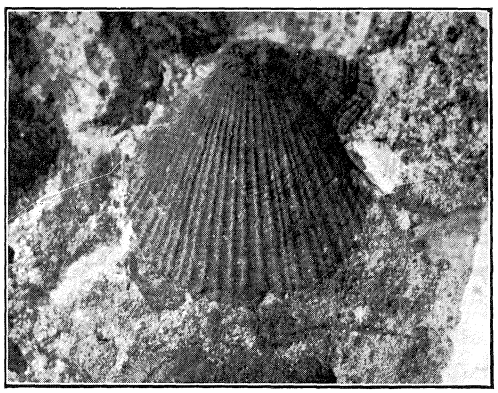
Fig. 1. External impression of a left valve with anterior ear preserved. North Head, Ulladulla, New South Wales.

Fig. 2. A left valve exhibiting convexity which is practically equal in both valves. North Head, Ulladulla, New South Wales.

Fig. 3. A photo-micrograph of a portion of Fig. 5 showing costæ which are all similar in size. Wyro, near Ulladulla, New South Wales.

Fig. 4. An external impression of Fig. 5. Wyro, near Ulladulla, New South Wales.

Fig. 5. A perfectly preserved left valve showing the relative proportions of the auricles and the shell ornamentation. Wyro, near Ulladulla, New South Wales.



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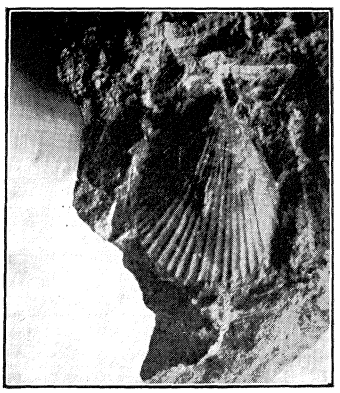

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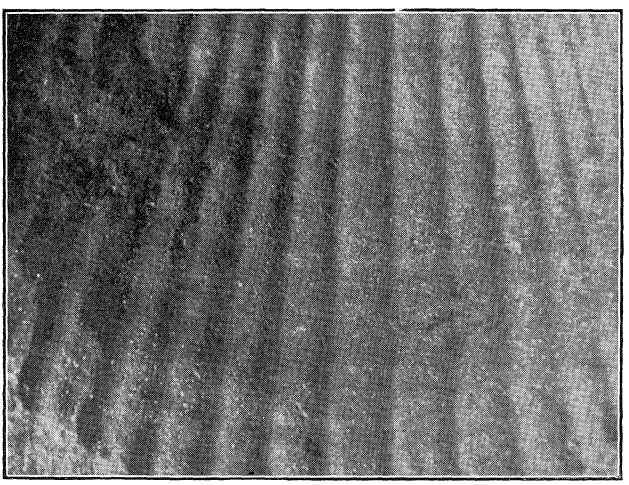

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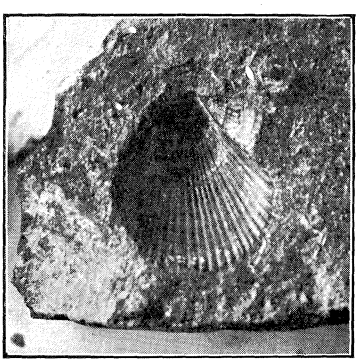

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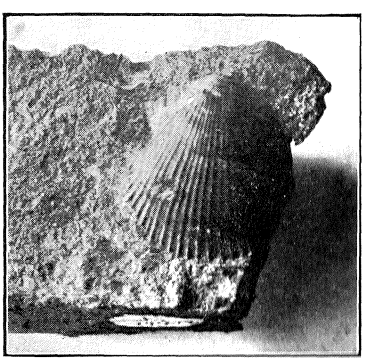

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G. C. Clutton, Photo.

EXPLANATION OF PLATE V.

Aviculopecten parkesi, sp. nov.

Fig. 1. A right valve exhibiting strong convexity. The posterior ear is not preserved. Wyro, near Ulladulla, New South Wales.

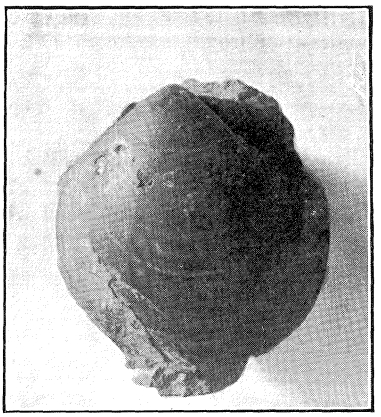
Fig. 2. A left valve showing equal convexity with the right valve, and the very fine costæ with which the valve is ornamented. Wyro, near Ulladulla, New South Wales.

Fig. 3. An internal cast of a left valve, which exhibits the deep byssal sinus, which separates the anterior ear from the body of the valve. Wyro, near Ulladulla, New South Wales.

Deltopecten lata, sp. nov.

Fig. 4. A left valve in an almost perfect state of preservation. Maitland district, New South Wales.

Fig. 5. A right valve showing both the auricles and the valve ornamentation. North Head, Ulladulla, New South Wales.



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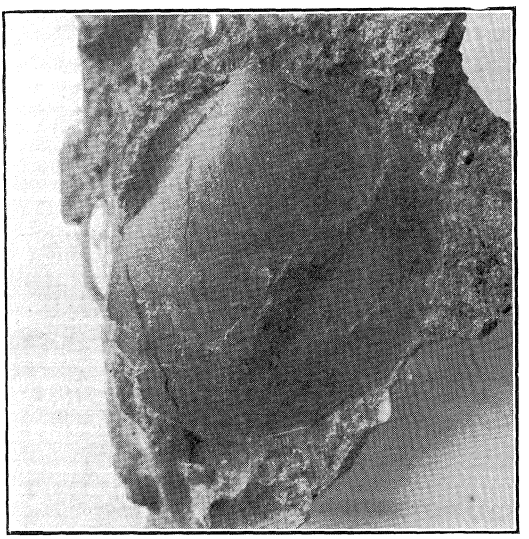

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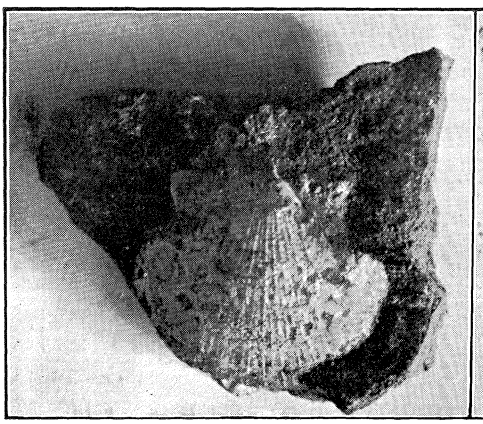

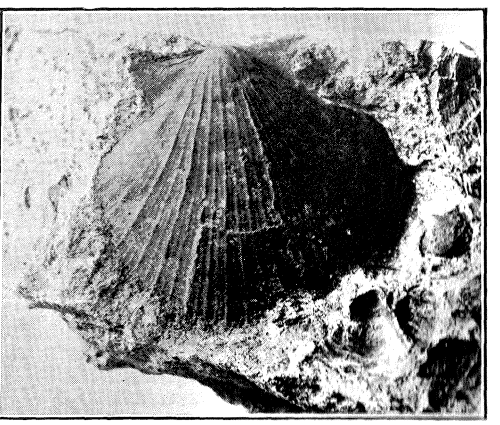

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G. C. Clutton, Photo.

EXPLANATION OF PLATE VI.

Deltopecten farleyensis, Eth. and Dun.

Fig. 1. An internal cast of a flattened right valve showing the extreme length of the dorsal margin in comparison with the height. The chondrophore pit is partly concealed. Jamberoo, New South Wales.

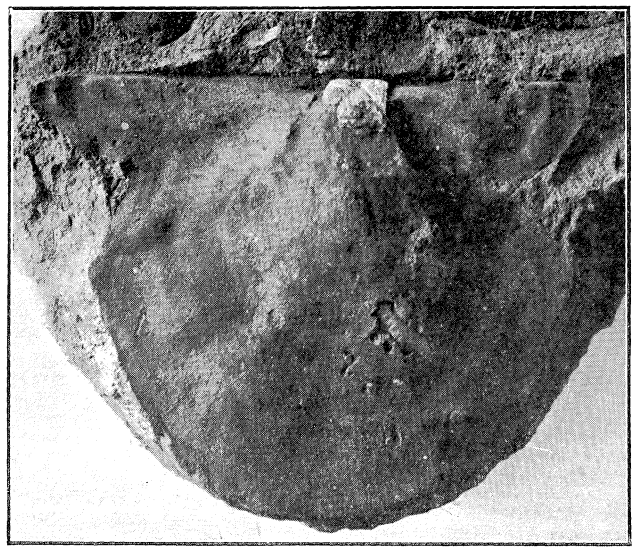
Aviculopecten englehardti, Eth. and Dun.

Fig. 2. An internal cast of a right valve showing obliquity, and the anterior auricle which is separated from the valve below by a deep byssal sinus; also an external impression of the left valve exhibiting the fine concentric markings of the valve. Ulladulla, New South Wales.

Fig. 3. An internal cast of a right valve showing the anterior auricle which is separated into two portions by a median depression. Wyro, near Ulladulla, New South Wales.

Deltopecten sp.

Fig. 4. An internal cast of a right valve showing chondrophore pit and the relative proportions of the auricles. The length of the lateral margins is well defined in this figure. Tianjarra, Wandrawandian Creek gullies, New South Wales.



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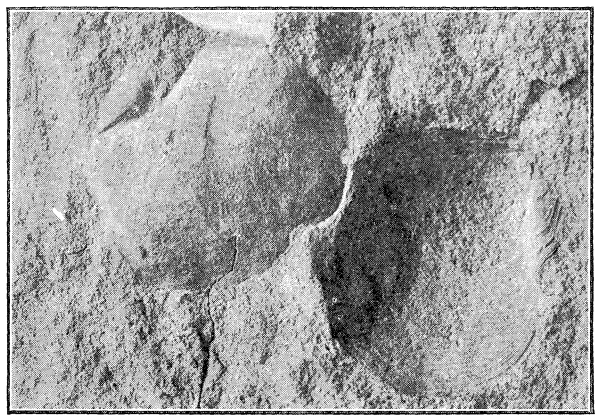

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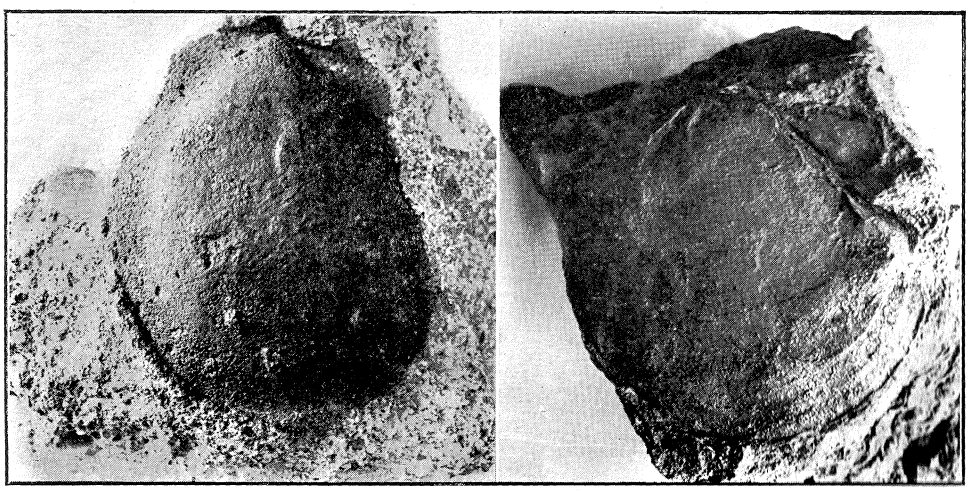

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G. C. Clutton, Photo.

EXPLANATION OF PLATE VII.

Deltopecten media (*Laseron*).

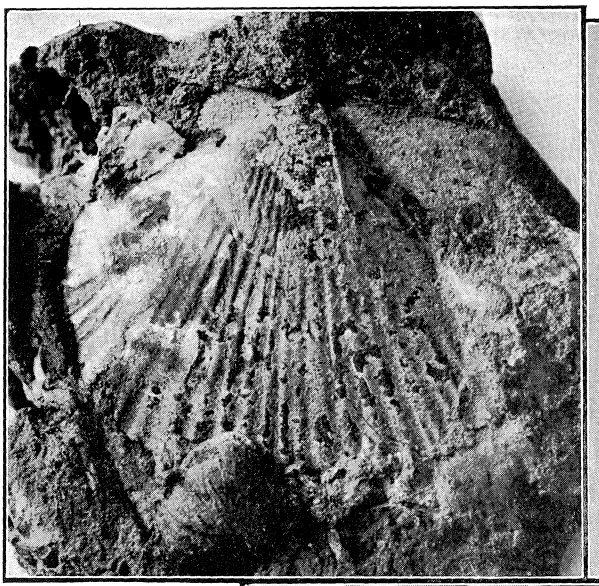
Fig. 1. An internal cast of a right valve, showing the valve sculpture. The relative proportions of the auricles are well defined in this figure, which also exhibits the byssal sinus and the chondrophore pit. Coast line between St. George's Basin and Ulladulla.

Fig. 2. Portion of a left valve showing the stronger convexity than the right. Wyro, near Ulladulla, New South Wales.

Fig. 3. The type specimen of *Aviculopecten media* Laseron. A left valve showing anterior auricle. Wandrawandian, New South Wales.

Fig. 4. An internal cast of a left valve exhibiting costæ. The chondrophore is just discernible. Coast line between St. George's Basin and Ulladulla, New South Wales.

Fig. 5. Internal cast of a left valve exhibiting portion of the hinge area of a right valve. Warden Head, Ulladulla, New South Wales.



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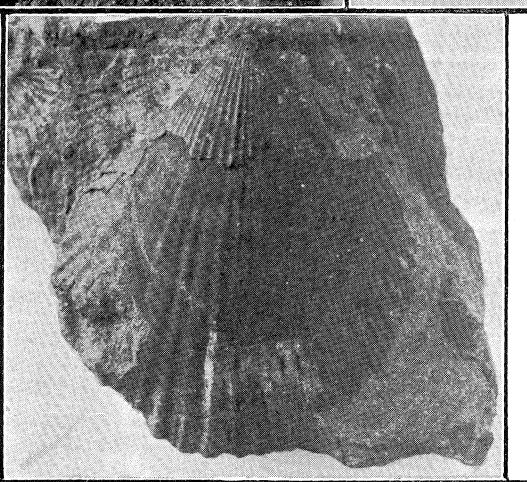

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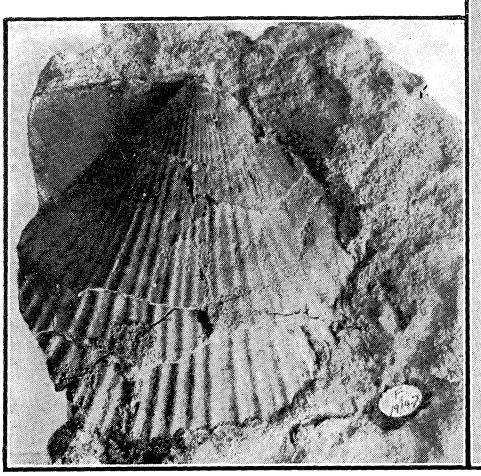

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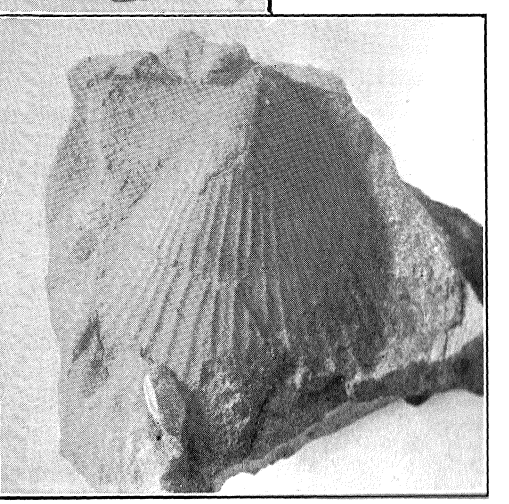

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G. C. Clutton, Photo.

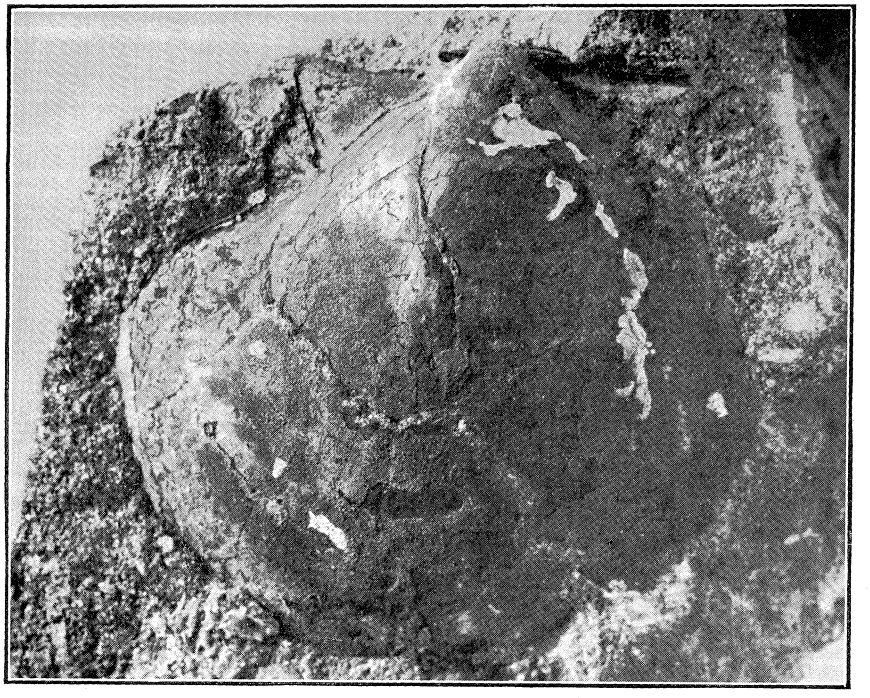
EXPLANATION OF PLATE VIII.

Deltopecten fittoni (*Morris*).

Coast line between St. George's Basin and Ulladulla, New South Wales.

Fig. 1. A slightly oblique internal cast of a left valve, exhibiting hinge area and the chondrophore, which is partly concealed by the umbo.

Fig. 2. An external impression of a left valve, which shows to advantage the characteristic sculpture of this species.



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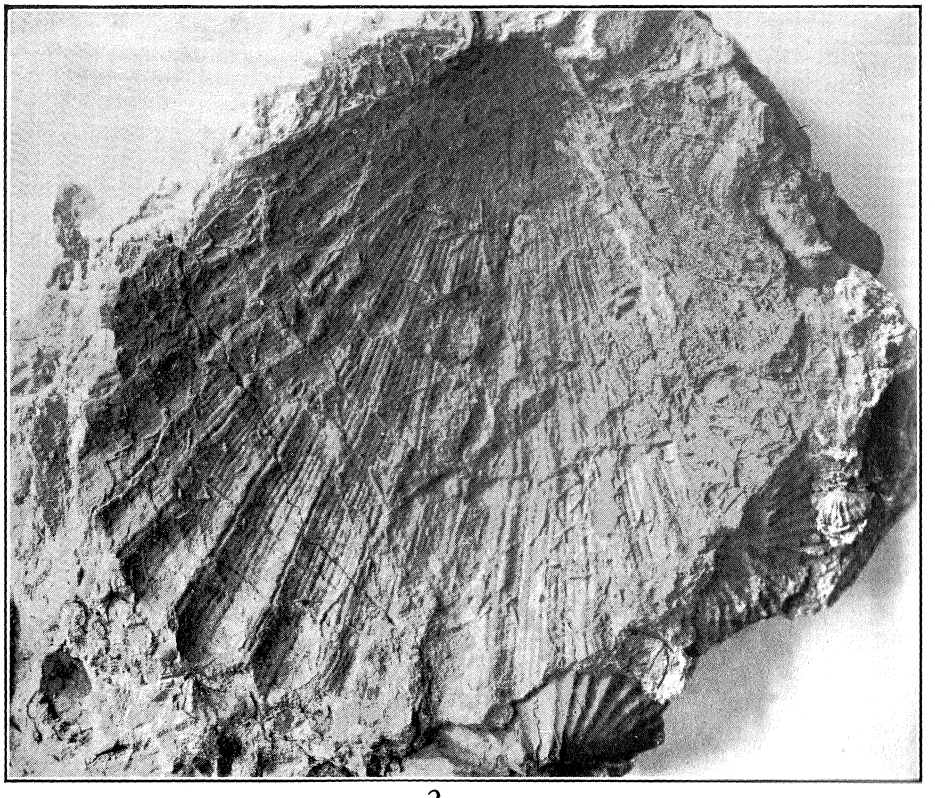

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G. C. Clutton, Photo.

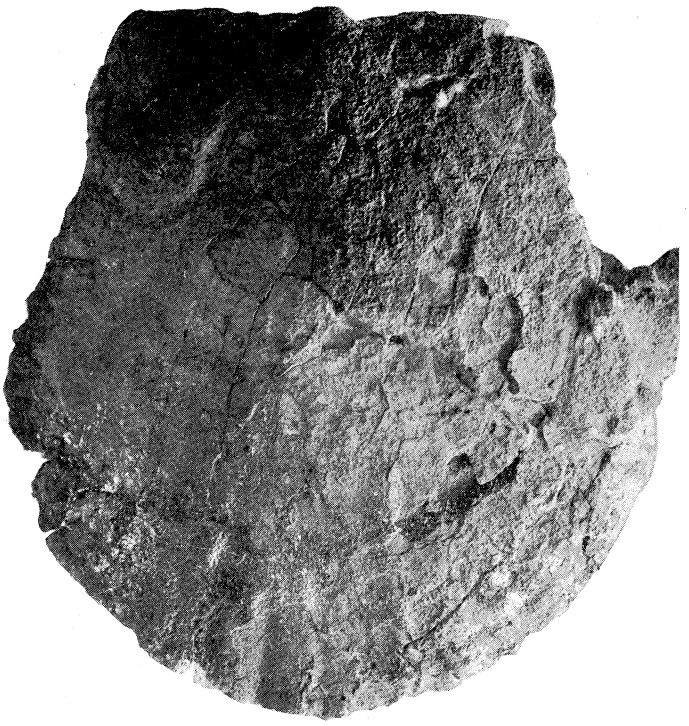
EXPLANATION OF PLATE IX.

Deltopecten depressus, sp. nov.

Kioloa, near Ulladulla, New South Wales.

Fig. 1. A large left valve of an adult specimen, showing the heavy folds and relative proportions of the auricles.

Fig. 2. An internal view of a left valve, showing the large chondrophore pit.



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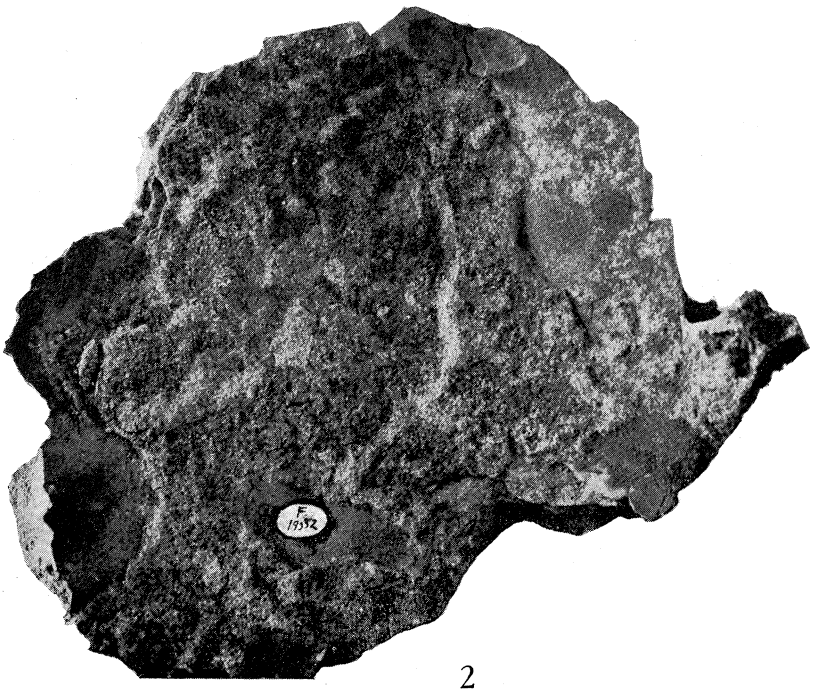

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G. C. Clutton, Photo.

EXPLANATION OF PLATE X.

Deltopecten depressus, sp. nov.

Kioloa, near Ulladulla, New South Wales.

Fig. 1. Portion of the very much flattened right valve, showing the posterior auricle and heavy valve sculpture.

Fig. 2. Left valve of an immature specimen, which exhibits the ornamentation (inferior in size to the adult) and the auricles.

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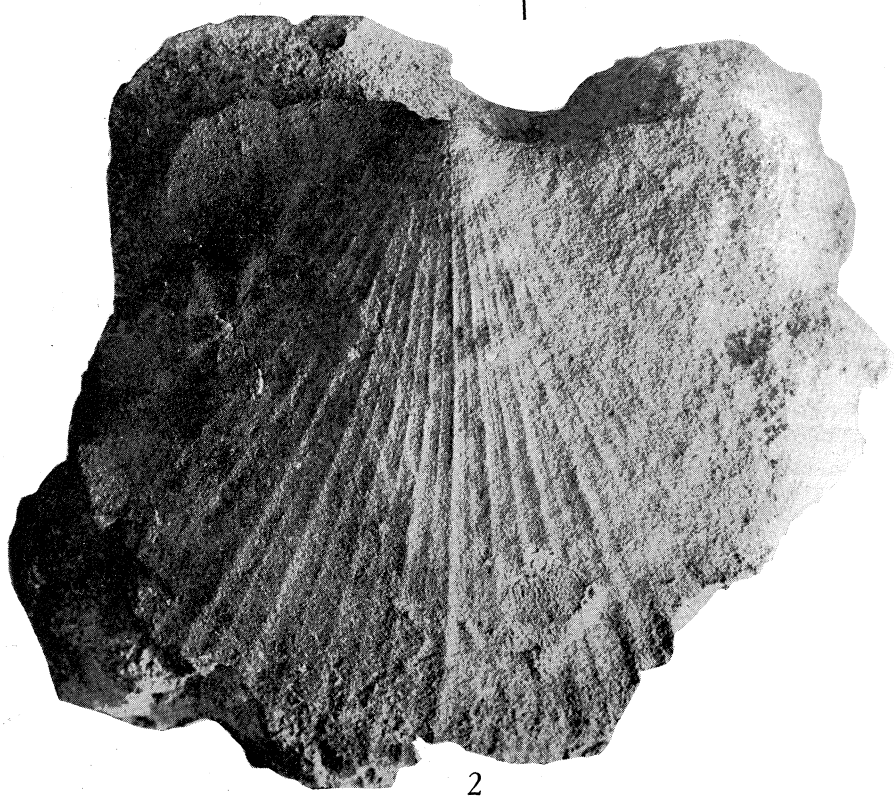

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G. C. Clutton, Photo.

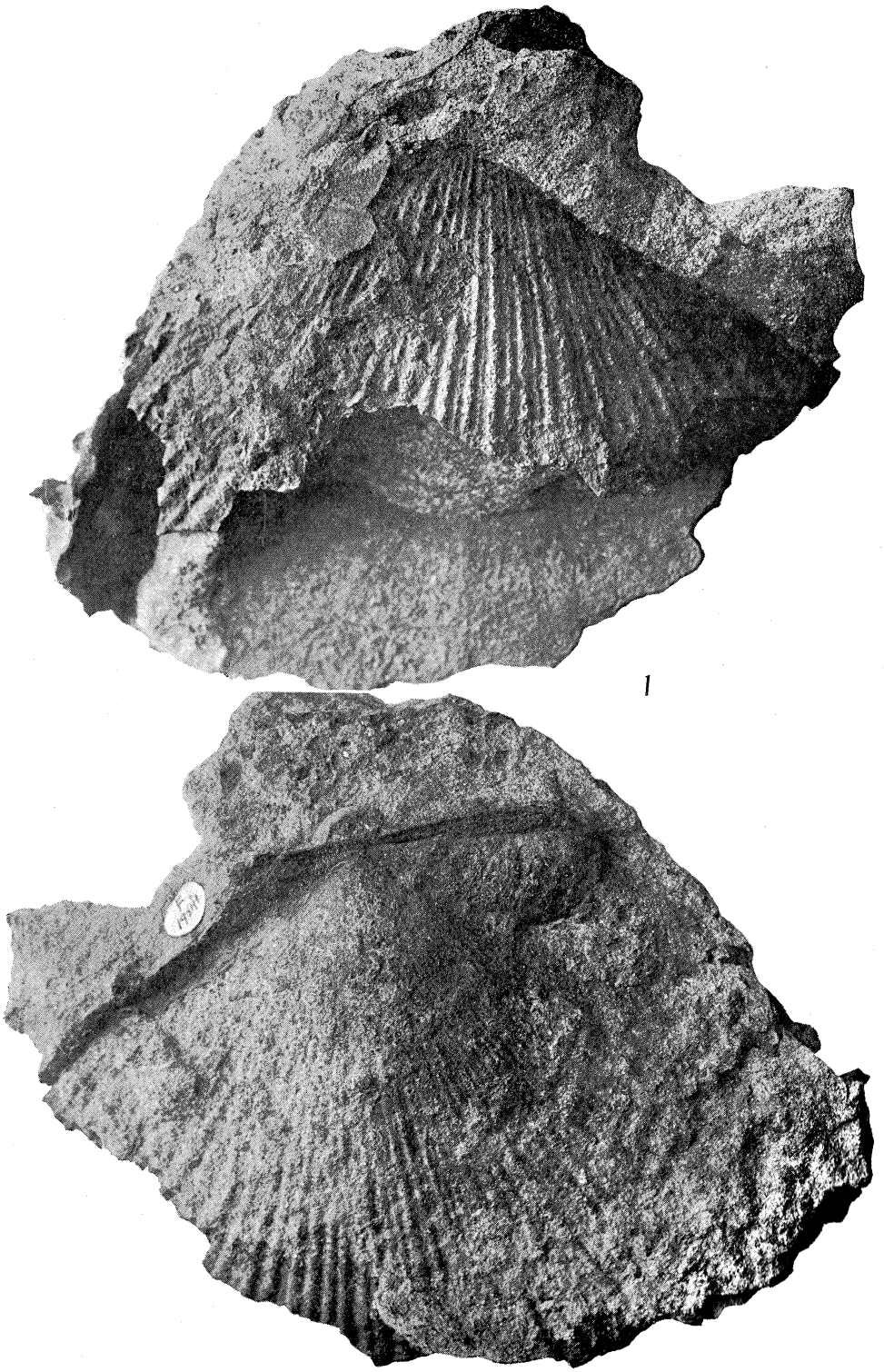
EXPLANATION OF PLATE XI.

Deltopecten cf. giganteus, Chao.

Kioloa, near Ulladulla, New South Wales.

Fig. 1. Portion of a left valve, showing the closely packed primary and secondary costæ.

Fig. 2. The right valve of Fig. 1, exhibiting the anterior auricle and valve sculpture. A portion of the hinge area and umbo of the left valve are visible.



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G. C. Clutton, Photo.

EXPLANATION OF PLATE XII.

Deltopecten leniusculus (*Dana*).

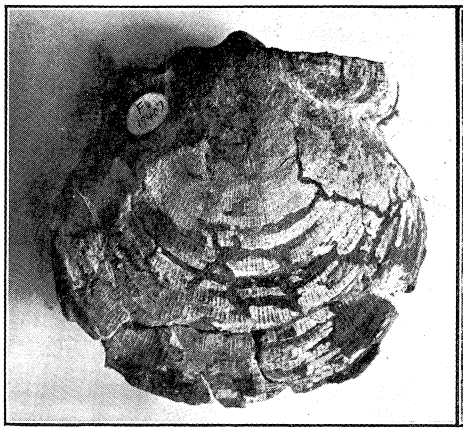
Fig. 1. A right valve exhibiting the valve ornamentation. Gerringong, New South Wales.

Fig. 2. An external impression of a right valve, showing relative proportions of the auricles. North Head, Ulladulla, New South Wales.

Fig. 3. An external impression of a left valve of a comparatively large specimen, showing the convexity and valve sculpture. Gerringong, New South Wales.

Fig. 4. The external impression of a right valve. North Head, Ulladulla, New South Wales.

Fig. 5. Photo-micrograph of a portion of a left valve showing (1) Primary and (2) Secondary costæ. Gerringong, New South Wales.



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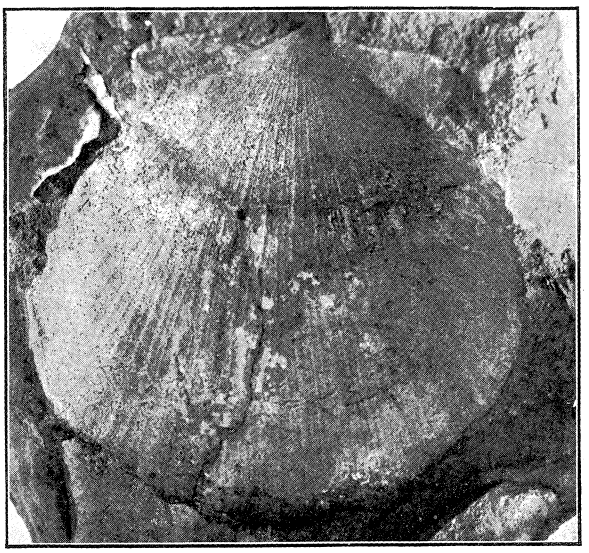

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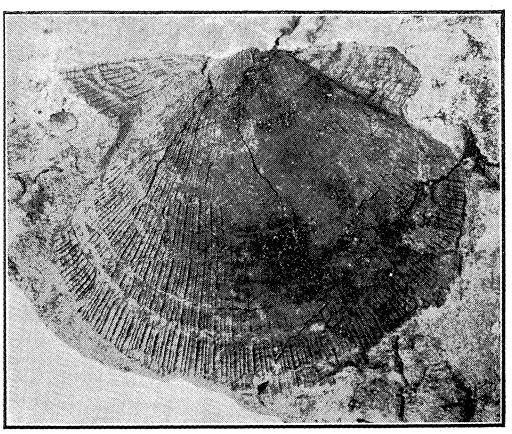

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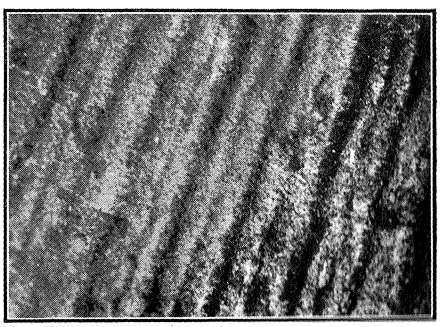

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G. C. Clutton, Photo.

EXPLANATION OF PLATE XIII.

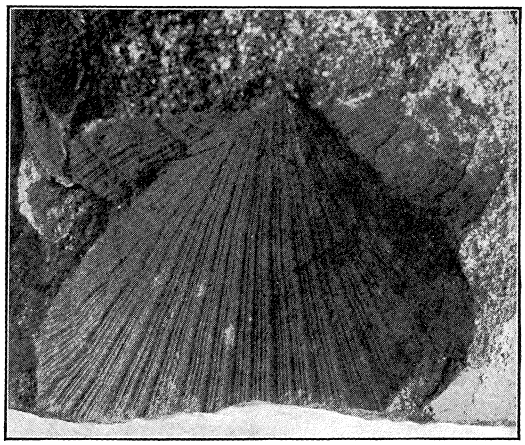
Deltopecten comptus (*Dana*).

Fig. 1. Portion of a left valve, showing the relative proportions of the auricles and the heavy primary costæ. Tianjarra, Wandrawandian Creek, New South Wales.

Fig. 2. An external impression of a left valve. Lake Tullawalla, St. George's Basin, New South Wales.

Fig. 3. A cast of Dana's type specimen of *Pecten comptus*. Illawarra, New South Wales.

Fig. 4. A photo-micrograph of a portion of a left valve, showing (*a*) Primary, (*b*) Secondary, (*c*) Tertiary costæ.



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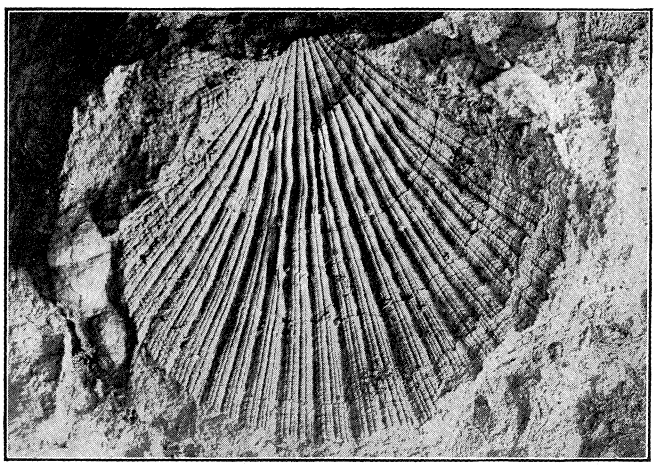

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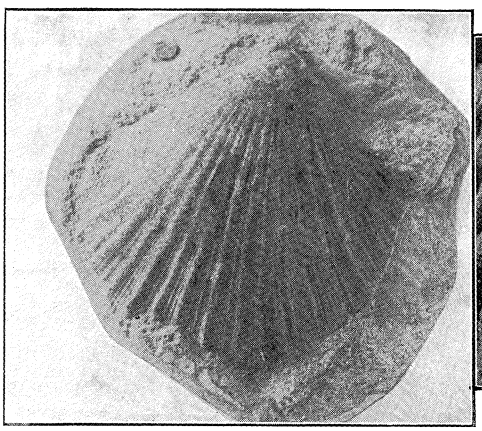

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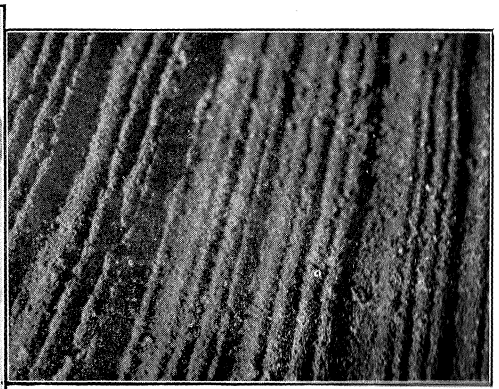

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G. C. Clutton, Photo.

EXPLANATION OF PLATE XIV.

Deltopecten clarkei, sp. nov.

Sussex Inlet, New South Wales.

Fig. 1. Internal cast of a flattened right valve, exhibiting costæ of the one type.

Fig. 2. Internal cast of a convex left valve, showing a small portion of the posterior auricle.

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G. C. Clutton, Photo.

EXPLANATION OF PLATE XV.

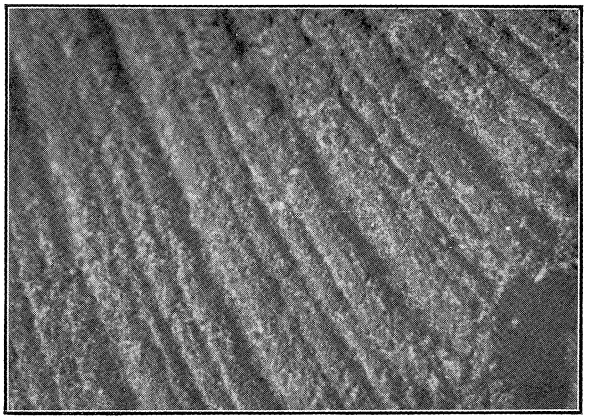
Deltopecten subquinquelineatus (*McCoy*).

Fig. 1. Photo-micrograph of a portion of a left valve, showing the (*a*) Primary, (*b*) Secondary and (*d*) Tertiary costæ.

Fig. 2. An internal cast of a left valve. Lake Tullawalla, St. George's Basin, New South Wales.

Fig. 3. A left valve, showing the relative proportions of the auricles. The chondrophore pit is partly concealed by the umbo. Conjola, near Milton, New South Wales.

Fig. 4. An external impression of a left valve. Both auricles are missing. Conjola, near Milton, New South Wales.



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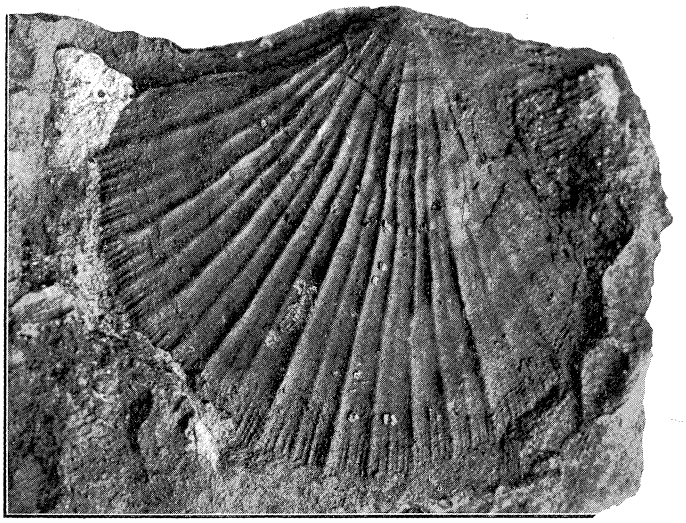

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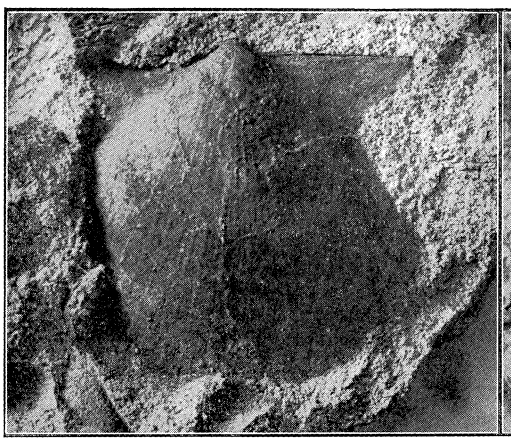

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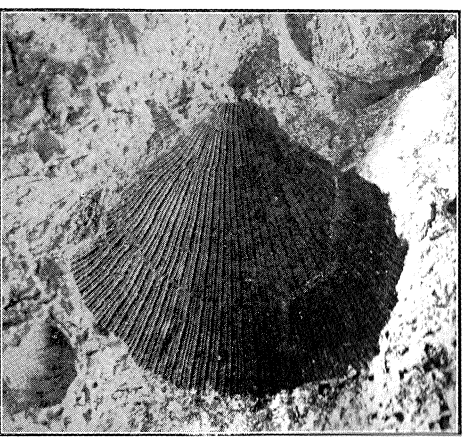

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G. C. Clutton, Photo.

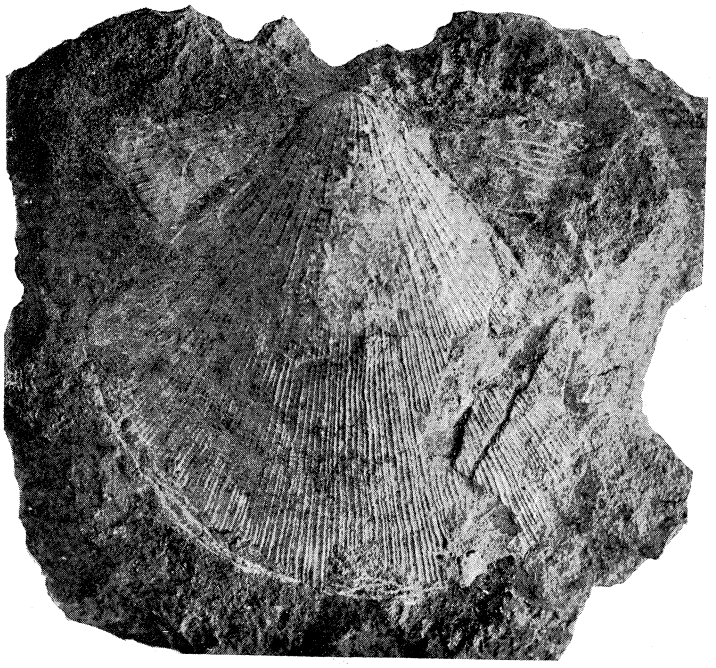
EXPLANATION OF PLATE XVI.

Deltopecten subquinquelineatus (*McCoy*) *var. delicatula, var. nov.*

Fig. 1. A left valve, exhibiting the relative proportions of the auricles and the valve sculpture. Ulladulla, New South Wales.

Fig. 2. External impression of a left valve. North Head, Ulladulla, New South Wales.

Fig. 3. A photo-micrograph of a portion of a left valve, showing (1) Primary and (2) Secondary costæ.



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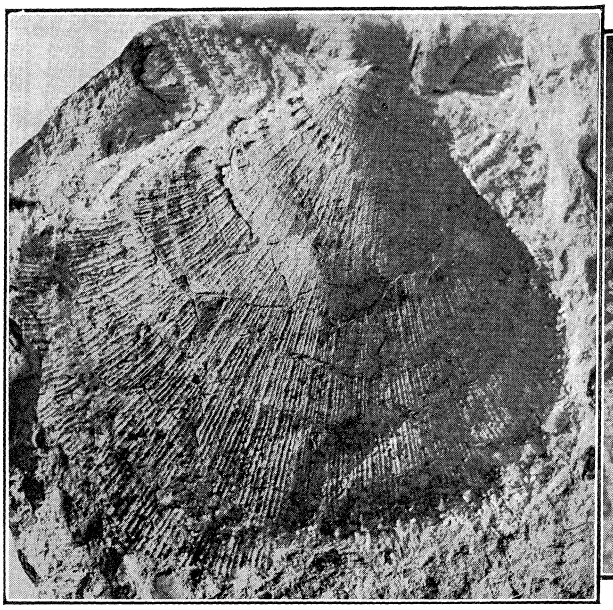

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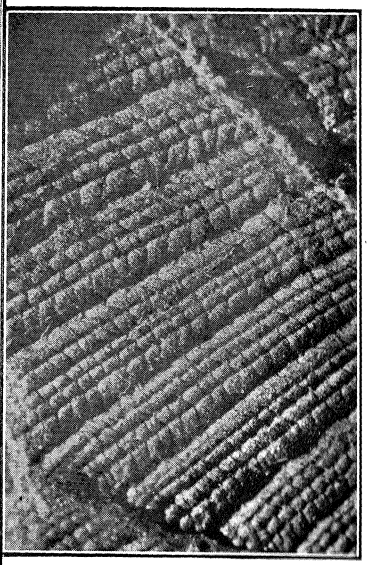

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G. C. Clutton, Photo.