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By

DOROTHY HILL

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(With 1 Text-figure and 9 Plates)

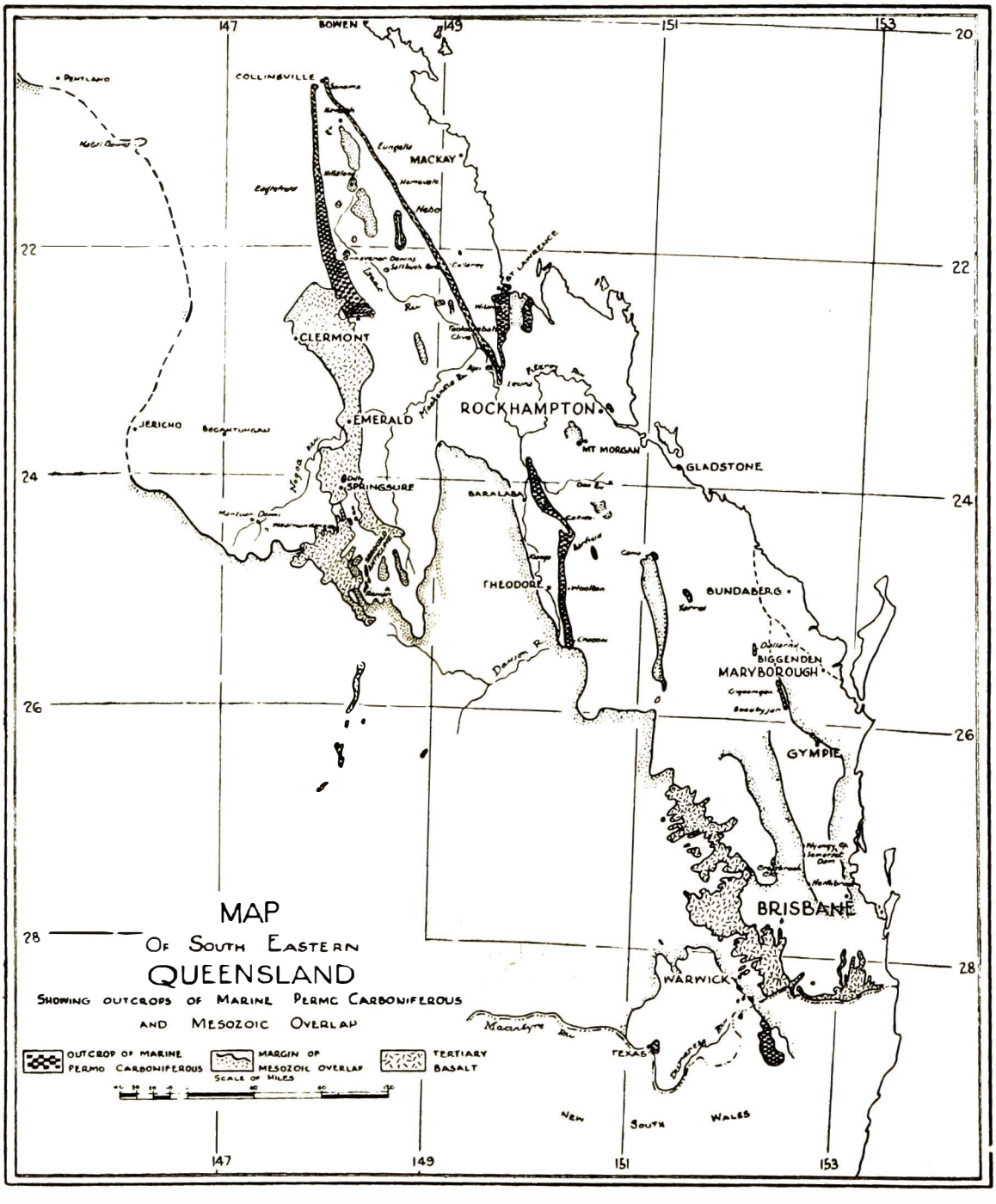
SUMMARY

The productinid fauna of Cracow homestead comprises *Taeniothaerus subquadratus* var. *cracowensis, Terrakea pollex, Anidanthus springsurensis, Cancrinella farleyensis, Horridonia mitis* and *Krotovia* sp., and these are described and the genera discussed herein. Comparison of this fauna with overseas assemblages shows that it is pre-Kungurian (i.e. pre-Permian, in accordance with the principle of priority of nomenclature) and post-*Triticites* zone of the Russian Upper Carboniferous; i.e. it is Artinskian and it seems closer to the early Artinskian (Sakmarian) than to the Upper Artinskian. The occurrence of species of the fauna elsewhere in Queensland is given.

The Cracow fauna discussed herein is contained in the highly fossiliferous marine shales and limestones outcropping in a low ridge ¼ to ½ mile W. from Cracow homestead, which is about 5 miles S. of Cracow township in the Dawson Valley. The fossiliferous beds overlie Permo-Carboniferous volcanics mainly andesitic agglomerates and are overlain by massive white fine-grained siliceous sandstones with sponge spicules as the only fossils. They are about 100 feet thick, with 10 to 12 feet of shales at the base, then approximately 50 feet of limestone, and an uncertain thickness of calcareous sandstones now decalcified and with the fossils frequently silicified.

The Productinae at Cracow station are *Taeniothaerus subquadratus* var. *cracowensis, Terrakea pollex, Anidanthus springsurensis, Cancrinella farleyensis, Horridonia mitis* and *Krotovia* sp. They make up but a small part of the fauna, which includes also two chonetids and several strophalosiids; spiriferids, streptorhynchids and dielasmids are the more important of the other brachiopods; stenoporids, fenestrellinids, platyschismids and eurydesmids are common.

One or more of these species are found in many outcrops of the earliest marine beds of the Permo-Carboniferous of Queensland. Thus beginning with the most south-westerly of these outcrops, the fauna occurs in a southerly extension of the Dilly Beds exposed in the heart of the Serocold anticline, south of Springsure; here *Taeniothaerus subquadratus* var. *acanthophorus* is associated with *T. pollex, A. springsurensis* and *C. farleyensis*. In the Springsure district the Dilly Beds form the oldest of three marine developments in what is dominantly a fresh-water development of the Bowen System. They are separated from the next marine beds, the 600-feet Ingelara Beds, by 1700 feet of non-marine sandstones; and this again is separated from the topmost marine band, the Mantuan Marine Band, rich in Productidae, by five or six hundred feet of non-marine mica clay shales and sand-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BARALABA
THEODORE
BUNDABERG
BIGGENDEN
MARYBOROUGH
GYMPIE
BRISBANE
WARWICK
TEXAS
NEW SOUTH WALES
MAP
OF SOUTH EASTERN
QUEENSLAND
SHOWING OUTCROPS OF MARINE PERMO CARBONIFEROUS AND MESOZOIC OVERLAP
OUTCROP OF MARINE PERMO CARBONIFEROUS
MARGIN OF MESOZOIC OVERLAP
TERTIARY BASALT
SCALE OF MILES

stones. Thereafter only fresh-water beds occur (Reeves, 1947, p. 1347). The Dilly and Ingelara Beds contain glacial boulder beds and the former is seen further north near Dilly, 7 miles N. of Springsure, where *Taeniothaerus* and *Terrakea pollex* are known.

North of Dilly on the same western limb of the great Bowen syncline, we cannot be sure that this Cracow fauna occurs. The only form recorded (Whitehouse, 1928, p. 285—I have not seen these two specimens) is *Cancrinella farleyensis* from Grosvenor Downs and Ney's Selection, and this species may have a longer range than the others. No characteristic Cracow species are known around the northern closure of the syncline, or southwards along the eastern limb, until we come to Blenheim, where *A. springsurensis* and *C. farleyensis* are associated, and Hazelwood Creek, 4 miles S.W. of Eungella Station, where *T. subquadratus* is recorded. Then at Homevale, Mt. Britton, there is a very rich Cracow fauna, with *T. subquadratus, T. pollex, C. farleyensis* and *A. springsurensis,* all common. At Saltbush Park, on Yatton Goldfield, on Mt. Bora and on Clive Creek, and at the Mackenzie-Isaacs River junction, *A. springsurensis* occurs. This eastern limb of the syncline is met a little further to the south by a belt of marine strata coming down from St. Lawrence in which the Cracow Productinae are found e.g. Wilangi (*Aulosteges randsi, A. springsurensis* and *T. pollex*) and Tooloombah (*C. farleyensis*). In a short belt parallel to this, as the eastern rim of the Styx coalfield, there are further localities for Cracow Productinae; e.g. Stoodleigh (*T. pollex*). The eastern limb of the syncline disappears under alluvial and Tertiary deposits at Leura, but reappears again just south of the Central Railway Line; and *A. springsurensis* occurs at various localities in the long belt stretching down the Dawson Valley to Cracow, where the fauna is typically developed and very rich, with *T. subquadratus, T. pollex, A. springsurensis, C. farleyensis,* and in addition two species not known elsewhere, *Horridonia mitis* and ? *Krotovia* sp. This eastern limb then disappears under the overlapping Triassic of the Great Artesian Basin.

East of the great syncline, the folding and faulting is much more complex, and the Cracow fauna occurs at several separate localities. The most northerly of these is Lake's Creek near Rockhampton where *T. subquadratus, A. springsurensis* and *C. farleyensis* occur; others are Spring Creek and Clonmel near Cania, where *A. springsurensis* is common; Yarrol on the Burnett River, where *T. subquadratus* var. *acanthophorus, A. springsurensis* and *C. farleyensis* are common; Gigoomgan (*A. springsurensis*); Gympie, where *A. springsurensis* and *C. farleyensis* characterise the First bed of Slate (Phoenix Slate—Maitland Slate) and the Top Limestone; in the Stanthorpe road block, Silverwood near Warwick, where *A. springsurensis* occurs near the base of the sequence, and finally near Texas (*A. springsurensis*). At all these localities, except perhaps those where only *C. farleyensis* occurs, the fauna is believed to be older than the Ingelara fauna, and probably equivalent to that of the Dilly Beds of Dilly and the Serocold anticline in the Springsure district.

The Cracow productinid fauna seems Artinskian. Here the Artinskian Stage is understood as representing the beds included between the base of the Sakmarian (zone of *Pseudoschwagerina*) and the base of the Kungurian in the Sterlitamak area and the vicinity of the Ufa Plateau; i.e. in its original sense of Karpinsky (See Dunbar, 1942, p. 402.).

Of the species represented, *T. subquadratus* is very close to *T. brenensis* from the Agglomeratic Slate Series of Kashmir, but is not similar to any *Aulosteges*

from Russia. *Anidanthus springsurensis* is very close to *A. aagardi* which in Russia (Stepanov, 1939) first appeared in the Sakmarian but flourished only in the later half of the Artinskian, and is less similar to the American *A. waagenianus* which enters first in the Wolfcamp (now correlated with the Sakmarian) but extends on into the Capitan limestone now generally regarded as equivalent to the Kungurian or Kazanian. *Cancrinella farleyensis* is perhaps closest to *C. cancriniformis*, which in Russia characterises the Sakmarian and later Artinskian, but is absent from Kungurian and Kazanian, and to *C. phosphatica* from the Phosphoria Formation of Utah, now correlated with the Sakmarian. *Terrakea pollex* belongs to an endemic Australian genus, and is therefore not helpful for overseas correlation. *Horridonia mitis* is very close to *H. pseudohorrida* from the Upper Carboniferous rocks (*Triticites*-zone and Sakmarian) of the Arctic regions. ? *Krotovia* sp. does not assist in stratigraphic discussion.

The Productinae thus indicate either a Sakmarian or later Artinskian age in terms of the Russian sequence and the older, Sakmarian, seems the more likely. They appear to be older than the European Zechstein and Magnesian Limestone.

PHYLUM BRACHIOPODA
CLASS ARTICULATA
ORDER PROTREMATA

Super Family Strophomenacea
Family Productidae Gray 1840

Sub-family Productinae Waagen 1884, p. 612, 613; Prendergast, 1943, p. 12.

Productids with dendritic muscle impressions and without teeth. Hollow Spines present over whole or part of the shell. Genera, *Productus* sensu lato, *Productella*, *Aulosteges* sensu lato.

In this paper the author follows the subdivisions of the family Productidae into the sub-families Chonetinae, Productinae and Strophalosiinae, as advocated by Prendergast (1943, p. 12) when discussing Western Australian Productidae.

Genus Aulosteges Helmerson

Aulosteges Helmerson, 1847, p. 331; Prendergast, 1943, p. 32. *Genotype*: *Aulosteges variabilis* Helmerson, 1847, p. 331, text fig. 1, abundant in the Permian Zechstein [Kazanian] limestones of Mt. Grebeni in the north of Orenburg, Russia; =*Orthis wangenheimi* de Verneuil, 1845, p. 194, from the same locality.

Diagnosis: Subquadrate concavo- or plano-convex shells with a median sinus and fold, with a tall area on the ventral valve containing a delthyrium closed proximally by a pseudo-deltidium frequently ornamented with spines, and without hinge teeth. Ornament of coarse tubular spines rising from elongated bases; the dorsal valve is typically without area, has the dendritic muscle scars of productinids, and a large trifid cardinal process typically perpendicular to the hinge-line; a triangular umbonal projection from the cardinal margin partially closes the delthyrium. Umbonal cementation present or absent.

Range: In Russia, Kazanian; doubtfully also *Schwagerina* zone. In Germany and England, Zechstein. In India Agglomeratic Slate Series of Kashmir to Middle *Productus* limestone. In Mongolia, Jisu Honguer Limestone. In China, Loping

Series. In E. Australia, near the base of the marine Kamilaroi (Permo-Carboniferous). In W. Australia, in the Fossil Cliff and throughout the higher horizons of the Kamilaroi. In N. America, Wolfcamp to Capitan Limestone.

Subgenera: (1) *Aulosteges;* shells with constant, tall, wide area divided by oblique lines from the umbo. Kazanian of Russia (Netschajew, 1911); lower and middle *Productus* limestones, Salt Range (Waagen, 1884); Jisu Honguer limestone, Mongolia (Grabau, 1931) Lopingian of Kiangsi and *Lyttonia* beds of Kueichow (Chao, 1928); Hess, Leonard, Word and Delaware Mt. formations, Texas (King, 1930); middle and upper Permo-Carboniferous of W. Australia (Hosking, 1931).

(2) *Taeniothaerus;* see below.

(3) *Wyatkina* Fredericks (1931, p. 211 footnote; Prendergast 1943, p. 35) subgenotype by original designation *Aulosteges gigas* Netschajew (1894, p. 155, pl. III, IV) from Gorodiste, R. Viatka at the mouth of the R. Pishma, lower Zechstein [Spirifer *rugulatus* beds, Kazanian]; shells with constant, tall wide area divided by oblique lines from the umbo. This may not be separable from the subgenus *Aulosteges.*

(4) *Strophalosiina* Licharew (1935, p. 369); subgenotype *Aulosteges tibeticus* Diener (1897, p. 35, pl. V, figs. 3-6). Geniculate shells with pustular ornament on visceral disc replaced by radial plications on the trail. Includes *S. costata* Waagen var. *subrotunda* Red (1944, p. 110; pl. xviii, figs. 12, 12a) from the Lower *Productus* Limestone and possibly *Aulosteges magnicostatus* Girty (King, 1930, p. 93, pl. XXV, figs. 1-48) from the Leonard and Word Formations of N. America. The coarsely costate European Zechstein *S. leplayi* and Indian *S. costata* may be related.

(5) A possible subgenus, of thin-visceraed shells with low, wide areas divided by oblique lines from the umbo, including *A. horrescens* (de Verneuil, 1845) *A. fragilis* (Netschajew, 1894), and *A. longa* (Netschajew, 1900) from the Russian Zechstein (Kazanian), and possibly *Productus umbonillatus* King (1850) from the English Magnesian limestone and German Zechstein.

(6) Possibly *A. wolfcampensis* King (1930), the earliest of the N. American species, from the Wolfcamp of Texas represents an independent development of a ventral cardinal area from a costate *Productus,* for its ornament is costate with pustular spines as in some *Linoproductus.*

Remarks: The genus differs from *Productus* sensu lato only in the presence of a cardinal area on the ventral valve, and those subgenera characterised by different ornament may well have developed from different productids by mixoperipheral growth in the ventral valve. The delthyrium is always extremely narrow and is closed in the umbonal region by a pseudo-deltidium which may bear spines; into this delthyrium projects a small triangular flap from the hinge-line of the dorsal valve. All the Russian species have their areas divided by a pair of oblique lines from the umbo. The genus does not appear closely related to *Strophalosia,* since there are no teeth, no area on the dorsal valve, and the musculature is dendritic, i.e. productoid rather than strophalosioid. The tentative subgeneric groups (2) to (6) are restricted in geographic and stratigraphic range, compared with the typical subgenus.

Aulosteges (? Aulosteges) randsi sp. nov.

(Pl. 6, figs. 1a-d)

Holotype: Geol. Surv. Q'ld. Specimen F. 1991a, and its counterpart F. 1991b, from the Permo-Carboniferous of Wilangi Station north of Granite Ck., Styx R., St. Lawrence.

Description: The holotype consists of the internal and external moulds of a ventral valve. This ventral valve is widest anteriorly, but of irregular growth, curving to one side; the specimen is somewhat crumpled on one side; the width near the anterior margin of the uncrumpled half of the shell is 25 mm. There is a shallow median sinus, the shell was evidently thin and the muscle scars not much impressed. The cardinal area is 14 mm. tall and 26 mm. wide; the umbonal part of the narrow delthyrium is roofed over, but the cardinal part is open; the shell is thickened a little along the line of junction of the pseudo-deltidium with the area. The external ornament of the area is unknown.

The valve has moderately coarse, tubular spines, arranged without great regularity.

A second specimen G.S.Q. F. 1992 from the same locality is associated with *T. pollex*. It is the internal mould of a ventral valve; but on this specimen the mould is compressed laterally in the umbonal slopes, possibly by shell thickening. The lateral profile is the same as in the holotype.

Subgenus Taeniothaerus Whitehouse

Taeniothaerus Whitehouse, 1928, p. 282; Reed, 1932, p. 12; Prendergast, 1943, p. 27.

Type species: (by original designation). *Productus subquadratus* Morris in Strzelecki, 1845, p. 284, Mt. Wellington and Mt. Dromedary, Tasmania.

Diagnosis: Large subquadrate or elongate oval *Aulosteges* with area on the ventral valve not invariably developed; when present it is concave, low and variable in width, with a narrow pseudo-deltidium, and is not divided into differently ornamented sections; cardinal process of varying inclination.

Distribution: The subgenus is recognised so far only in the Permo-Carboniferous of Eastern and Western Australia and India. In E. Australia only one species is recognised at present, confined to the marine beds near the base of the sequence, while in W. Australia specimens referred to the type species by Teichert (1941) and Prendergast (1943) occur at various horizons from the Irwin River Fossil Cliff beds to the top of the sequence. In India there are two species, very close to the genotype, from the Agglomeratic Slate Series of Kashmir, which is well below the Lower *Productus* Limestone (Reed, 1932, p. 12) and two from the Lower *Productus* Limestone (Reed 1944, p. 75) which differ from the older species in ornament. Grabau (1931, p. 528) records *Productus* aff. *subquadratus* from near Vladivostock, Siberia.

Taeniothaerus subquadratus (Morris)

(Pl. 1, figs. 1a-c; pl. 2, figs. 3-6; pls. 3, 4, 5; pl. 6, figs. 2-4)

Productus subquadratus Morris in Strzelecki, 1845, p. 284, Mt. Wellington and Mt. Dromedary, Tasmania. According to Mr. Meston, Geological Survey of Tasmania, Strzelecki's locality, on the east side of Mt. Wellington (above Mr. Hull's house), is about 2 miles S.W. of Glenorchy railway station. A. N. Lewis'

map of the Hobart district (1946) shows this vicinity to be in beds of the Cascades stage, and his text (p. 30, 31) indicates that Strzelecki's locality was probably in the fossiliferous limestones outcropping about the Upper Glenorchy reservoir. These are regarded by Lewis as belonging to the Granton sub-stage of the Lower Marine Series of Tasmania.

Lectotype (chosen Prendergast, 1943, p. 27): British Museum specimen 91171, with locality label "Tasmania", figured herein, pl. 1, figs. 1a-c [possibly from the Granton substage of the Cascades stage].

Diagnosis: "Shell large, subquadrate to oval in outline. Greatest width near anterior margin. Pedicle valve strongly and evenly convex with median sinus, with or without cardinal area. Brachial valve slightly convex to concave with upturned margins. Ornament of coarse tubular spines, with spine bases elongated posteriorly. Concentric lamellae or wrinkles crossing shell surface. Muscle scars and reniform impressions productoid. Cardinal process vertical to inclined almost to horizontality. Median septum in brachial valve." (Prendergast, 1943, p. 28, based on Tasmanian specimens).

Remarks: The lectotype is a partly decorticated ventral valve, showing the rather fine, close spine ornament and a neat and regular globosity. A specimen I have (U.Q. F. 11050) from the Granton sub-stage of Granton Quarry near Mt. Dromedary, Tasmania shows a fringe of spines like that of *T. permixtus* of the Agglomeratic Slate Series of Kashmir, and this is seen also in varieties from Cracow and Springsure (See Pl. 2, fig. 4).

The species is found in Tasmania, northern N.S.W. (Drake district) and in Queensland almost at the base of the marine sequence of Kamilaroi; but in Western Australia records indicate a longer range. The material I have from Queensland differs in appearance from locality to locality, and although this depends in part on preservation and distortion, at least two varieties can be recognised. One of these is the community from the southern extension of the Dilly Beds in the Serocold Anticline in the Springsure district (Little Gorge Ck.; Consuelo Ck.; 2 miles above Cattle Ck.) and at Dilly itself. This has been described by Fletcher (1945, p. 314, pl. xxiii) as *Aulosteges acanthophorus* and while it may as Fletcher considered, represent a distinct species it seems to me only a variety of the eastern Australian *subquadratus*. The greater width of the hinge-line and the shortness of the trail distinguishes the community from those of Cracow and of Tasmania, and the ornament seems coarser than in the latter, though the characters of the area seem identical in all three. It is figured herein, pl. 2, figs. 3a-c, 4, 5a, b. Fletcher considers specimens from Yarrol near Monto, to be *acanthophorus*. Specimens from Lake's Ck., near Rockhampton also have wide hinge-lines and short trails, but they have been subject to considerable distortion and are at present identified with *T. subquadratus*. (Pl. 6, fig. 4).

A second variety is that formed by the community from Cracow, described below, and distinguished by the coarse ornament, heavy umbonal shoulders, and long coarse trail, which is well developed even in the smaller specimens.

Shells from Mt. Britton, Richard's and Dullawanna (which three localities are probably one and the same, i.e. "Fossil Hill" in subdivisions 1, 2, 3, and 4 just north of the junction of Moonlight and Oxley Creeks, north of Nebo), and others from Little Bowen River (Hazelwood Creek) 4 miles S.W. of Eungella Station have been filled with a very fine limonitic mud, and show no crushing or

distortion at all; the width of hinge-line and the globosity corresponds very well with the Tasmanian lectotype, though the ornament seems a little coarser.

The Western Australian material appears to represent different species. Thus specimens from Irwin River Fossil Cliff beds (Prendergast, 1943, p. 28 are invariably smaller than the lectotype, with less convexity, and with still finer ornament and relatively short hinge-line, the cardinal area being low and concave, extending the full width of the hinge-line. Specimens from higher horizons have taller areas.

TAENIOTHAERUS SUBQUADRATUS VAR. CRACOWENSIS VAR. NOV.

(Pl. 3, pl. 4 and pl. 6, figs. 2, 3)

Holotype: F. 10741, University of Queensland (Coll. D. Hill, 1947). Ridge $\frac{1}{4}$-$\frac{1}{2}$ mile west by north of Cracow Homestead, Dawson Valley, Queensland. Cracow fauna (Artinskian), Kamilaroi System.

Diagnosis: *T. subquadratus* with relatively coarse ornament, narrow hinge-line, heavy umbonal shoulders and long, coarse trail.

Description: The shell is productoid and very large, inflated, with a long trail, and elongate oval in outline. The average adult specimen is about 75 mm. high, and 65 mm. thick, with the maximum width (at the anterior margin) 70 mm., and a length of 170 mm.; the width of the hinge-line is 45 mm., and the width between the overhanging umbonal shoulders directly below the hinge-line 50 mm.

The ventral valve has a long trail which only gradually increases in width anteriorly; its flanks are steep and flattened and extend forward 12 to 15 mm. from the ears, with which they form almost a right angle. The sinus is shallow, and on the venter is parallel sided. The amount of umbonal angle is about 80°, and the umbo projects about 10 mm. below the plane of the hinge and the visceral portion of the dorsal valve. The projection is usually accentuated by shell crushing. The umbonal slopes overhang the ears (about 20-25 mm. below them) by about 2.5 mm. and this also is usually accentuated by slight crushing of the shells. The umbo of the ventral valve is usually some distance from the hinge-line, and a cardinal area then appears, but is low and not so wide as the hinge-line, with a small narrow pseudo-deltidium just below the umbo, and a small triangular delthyrium between this and the hinge-line; a small triangular projection from the dorsal surface of the hinge-line of the dorsal valve fits into the delthyrium. The curvature of the ventral valve is high and in uncrushed specimens is seen to decrease slightly anteriorly. The height of the visceral disc is about 30 mm.

The ornament of the ventral valve is of coarse tubular spines about 1 mm. in diameter, rising at the anterior ends of short radial ridges up to about 5 mm. long and a little less than 1 mm. wide. The spine bases may be 2 or 3 mm. apart, and there is no great regularity in arrangement. The spines from the flanks project nearly at right angles to the flanks, forming a thick horizontal fringe; those from the visceral parts take a course nearly parallel to the valve surface. The lines of spine bases near the sight median sinus on the anterior part of the ventral valve tend to converge in this sinus.

The dorsal valve is flat in the visceral disc portion, about 65 mm. long and 65 mm. wide and has lateral and anterior margins downturned nearly at right angles to form the trail; there is a very low median fold, more distinct anteriorly. There are short radial grooves on the surface, corresponding apparently to the short radial "spine bases" on the surface of the ventral valve. The spines arise without

radial spine bases and seem to be but little slenderer than those of the ventral valve and to be almost as numerous. Radial plications are developed on the trail.

Internal characters. The ventral valve develops a thickened roll of shelly matter behind the cardinal area. There is an outer pair of striated muscle marks, over almost the whole of the umbonal shoulders in the proximal half of the visceral disc; inside these is a pair of slender dendritic scars, and a narrow groove along the mid line of the sinus. The shell is considerably thickened at the anterior and posterior ends of these dendritic scars and in the umbonal region. The rest of the shell may be marked with numerous small shallow pits. A mould is figured in Pl. 4, fig. 3a-c.

The dorsal valve is reinforced just anterior to the hinge-line by a broad ridge of thickening; its muscle scars which are broad and dendritic, are set on a platform of callosity; radiating furrows in the scars are directed to a point nearer to the hinge-line than the centre of the scar; this point is distant from the hinge-line about one-fourth of the length of the visceral disc. The cardinal process is thick and large, and may be in the plane of the shell or inclined ventrally. It has a median furrow on its ventral surface which dies away posteriorly, to be replaced by two lateral furrows which make its end trifid; the median furrow dies away at the level of the hinge, and immediately anterior to this the median septum arises and continues almost the whole length of the visceral disc. One internal mould only shows the brachial impression. This is a loop which begins near the septum just anterior to the muscle scars, proceeds a short distance towards the ears and then turns out at right angles to the septum until near the margin of the disc, when it turns and runs anteriorly and then curves rapidly back on itself. The callosity is much greater in some shells than others, and with it the sharpness of definition of the muscle marks.

Genus Anidanthus Whitehouse

Anidanthus Whitehouse, 1928, p. 282.

Genotype (as cited by Whitehouse). "A new species of productid (figured in Jack and Etheridge)" (1892) as *Productus* sp. ind., Jack and Etheridge, 1892, pl. 12, fig. 16 (error for fig. 17 *fide* Whitehouse *in litt.*) Burnett District; pl. 44, fig. 13 Yatton Goldfield. As shown herein these figured specimens are conspecific with *Linoproductus springsurensis* Booker, 1932, p. 66, pl. iii, iv, from the upper section of the southern extension of the Dilly Beds exposed in the Serocold anticline, south of Springsure.

Whitehouse proposed this generic name in the following footnote "(3) a new genus proposed for a species of productid (figured in Jack and Etheridge). Geol. and Palaeont. Q'land and New Guinea, pl. 12, fig. 16 (*Sic;* error for 17 *fide* Whitehouse *in litt.*); pl. 44, fig. 13. The genus is known in other countries and ranges from the top of the lower Carboniferous to the Permian. It is being described elsewhere."

Whitehouse did not give a specific name to the figured specimens he cited but since he referred to published figures and used binary though not binominal nomenclature, his genus appears to me to be valid. The genotype did not have a specific name until 1932, when Booker described *Linoproductus springsurensis.* I have compared the two figured specimens mentioned by Whitehouse with the holotype of Booker's species, and am satisfied that they are identical with it. Booker's species differs from *Linoproductus* in having concentric ornament on the dorsal

valve. This case has been submitted to Secretary Hemming of the International Commission on Zoological Nomenclature, and pending the result I regard *Anidanthus* Whitehouse 1928 as a valid genus. In case this genus be ruled invalid however, I publish the name herein, and name *Linoproductus springsurensis* Booker 1932 described herein as type species of *Anidanthus* Hill nov.

Diagnosis: Productoid shells, concavo-convex and geniculate, with long auriculate hinge-line, no areas, and no teeth; ornament of ventral valve of costae only; ornament of dorsal valve of costae and coarse transverse lamellation giving a reticulate pattern; spines seldom developed; musculature productoid, cardinal process bifid; a short, high median septum developed in the dorsal valve.

Remarks: The genus seems close to *Linoproductus* Chao, but unlike that genus has different ornament on the two valves, the dorsal being reticulate and the ventral costate.

Range: In Australia the genus is known only from the early Kamilaroi (Permo-Carboniferous) of Queensland and New South Wales, where its protremate associates are *Taeniothaerus subquadratus, Cancrinella farleyensis, Lissochonetes* sp. nov., *Terrakea pollex* and *Strophalosia* spp.

Overseas the genus has a wide geographic range. Its earliest known appearance was in the Arctic and Russian species *P. aagardi* (Toula, 1875, p. 235, pl. vii, fig. 2) in the pre-*Schwagerina* and *Schwagerina* beds of Spitzbergen (Frebold, 1937 p. 31), together with specimens close to *P. aagardi* but referred to *P.* aff. *waagenianus* by Frebold (loc. cit.). Stepanov (1939, p. 759) records that in Russia *A. aagardi* first appeared in the Uralian complex (zones of *Pseudoschwagerina, Schwagerina moelleri* Schellwein and *Schwagerina anderssoni* Schellwein) but flourished only in the later zones (Artinskian complex of Stepanov) of *Parafusulina lutugini* Schellw., where it is encountered in great abundance. It is not known from the true Permian (Kungurian and later) of Russia, nor from the Permian of Germany or Britain.

In the Himalayan region the genus is known from several places, from specimens referred to *P. aagardi* Toula or *waagenianus* Girty, e.g. in the Karakorum, in beds referred to the *Schwagerina*-zone by Merla (1934); in Kashmir, in the Zewan beds of Mandakpal (Diener, 1915); at Chitral in beds correlated by Reed (1925) with the *Schwagerina* zone of Russia, and in the Middle Productus Limestone of the Salt Range (Reed, 1944, p. 56). The genus is not known from Mongolia or China, unless the brachial valves referred by Huang (1932) to *Linoproductus interruptus,* from the *Lyttonia* beds, belong to it. In North America, *P. waagenianus* Girty (1908, p. 253, pl. xii) is recorded by King (1930, p. 77) as ranging from the Wolfcamp (Sakmarian) through the Leonard and Word Formations into the Capitan Limestone now regarded as Kungurian or Kazanian. This species has finer costation than *A. aagardi,* and King includes within it *P. eucharis* Girty (1910, p. 28, pl. ii, figs. 3-4) from the Phosphate beds of Utah, now regarded as equivalent to the Wolfcamp, i.e. to the Sakmarian *Schwagerina* zone.

Anidanthus springsurensis (booker)
(Pl. 7, figs. 1-6)

Productus sp. ind. Etheridge in Jack and Etheridge, 1892, pl. 12. fig. 17 (non Whitehouse, 1928, p. 282, "fig. 16", error for 17); [Yarrol], Burnett District.

Productus sp. ind. Etheridge in Jack and Etheridge, 1892, pl. 44, fig. 13, Yatton Goldfield.

Linoproductus springsurensis Booker, 1932, p. 67, pls. iii-iv, Upper section of southern extension of Dilly Beds, exposed in Cattle Ck. and Little Gorge Cks., Serocold anticline. *Holotype* (by original designation); that figured pl. iii, figs. 1, 2, from Cattle Ck.

Diagnosis: Shell about 10 mm. high, 33 mm. wide, and 15 mm. thick or 1 : 3.3 : 1.5, laterally elongated, maximum width along hinge. Ventral valve with slightly convex visceral disc, geniculated to form convex trail, venter wide and flattened or shallowly sinuated; umbonal angle 110°; ears large, produced and projected proximally at their ends. Costae about 18 in 10 mm., spine bases very rare. Dorsal valve geniculated with flat or slightly concave visceral disc; median septum short and oblique lateral ridges prominent; costate ornament broken by angular concentric lamellation.

Description: External. Ventral valve. The shell is moderately convex for about 10 mm. from the umbo, with a median flattening; and then a geniculation develops, a trail about 8 mm. long forming with smaller convexity and venter flattened or even broadly and shallowly sinuate. The flanks are convex and in mature shells the width between them is much less than that along the hinge-line, and they are sharply marked off from the ears by the change of plane. The umbonal shoulders are separated from the large ears by a sulcus. The cardinal extremities of the ears are rounded and somewhat expanded, projecting a little proximally and dorsally. The umbo is rounded and slightly incurved, and projects for about 0.5 mm. beyond the hinge, which is without cardinal area or hinge teeth. The costae radiate evenly from the umbo to the anterior margin, increasing by intercalation; there are usually about 18 in 10 mm.; the grooves between the costae have the same width as and equal but opposite curvature to the costae. They are crossed by very fine growth lineation. Spine bases are rare, no more common on the ears or cardinal margin than elsewhere.

Dorsal valve. The visceral disc is slightly concave, with a median flattening, and a geniculation is developed at its anterior extension, joining it to the slightly concave trail. At this junction in mature shells, a wrinkle extending from the inner margin of the ears may give the effect of a cinctus in some shells. The venter is flattened. The ears are produced laterally beyond the flanks. The costae are similar to those of the pedicle valve, but there is in addition a concentric ornament, formed by periodic growth lamellation; every mm. or so, shell growth proceeds immediately below the previous plane; so that the abandoned edges of the shell are left in angular ridges normal to the plane of the shell, and the costation is interrupted by these smooth vertical faces. This lamellation continues on to the ears; in the early stages it proceeds straight across them from flanks to hinge-line; but in mature parts of the shell it is projected outwards on the ears, and meets the hinge-line at an angle.

Internal. Ventral valve. As a rule no or only faint traces of the costation are visible on the internal mould. Muscle scars are productoid and slightly raised, and there is usually a slight thickening of the shell in the umbonal region.

Dorsal valve. A short median septum (about 5 mm. long) is characteristic and is usually suddenly tallest at its anterior end. Two low oblique ridges divide the ears from the visceral disc, and meet the median septum at the hinge-line. The trigonal adductor muscle-scars lie proximally between these ridges and the median septum; the brachial loops are small. The visceral disc is sometimes bounded by a cinctus-like wrinkling.

Remarks: I have compared the two figured specimens cited by Whitehouse with the holotype and topotypes of Booker's species, and am satisfied that they are conspecific. The contrast between the reticulate appearance of the brachial valve and the radial ornament only of the pedicle valve is characteristic. There are wrinkles on the inner part of the ears, and one of these sometimes appears continuous around the edge of the visceral disc of the brachial valve, giving the appearance of a cinctus.

Range and Distribution: This species has a maximum in the Springsure district at the top of the southern extension of the Dilly Beds in the Serocold anticline. It occurs in enormous numbers at the top of the marine sequence of Yarrol, Burnett District. Near Cracow homestead a few specimens have been collected from the decalcified shales at the top of the Cracow limestone. On the Gympie Goldfield it is fairly common in the First (or Phoenix or Maitland) Slate at Dawn Pocket and elsewhere, and in the somewhat higher Upper (or Top) Limestones of many localities. It is very common at one horizon 4 miles E. of Texas, and at Lake's Creek Quarry, Rockhampton. It occurs at Spring Creek and Clonmel, Cania District, and at Gigoomgan and on the Yatton goldfield. At Silverwood it occurs in the Stanthorpe Road Block, near the base of the sequence there. It is not known in the northern end of the Bowen syncline, but is fairly common at Mt. Britton, near the base of that marine sequence. All these localities are considered to be roughly equivalent to the Dilly Beds of the Springsure area.

In New South Wales it is common in the Northern Rivers District only; but two specimens are known from the Farley Stage of the N.S.W. Lower Marine, and one from the "Upper Marine" of Ulladulla, Southern Coalfield of N.S.W. No specimens are known from Western Australia, but British Museum specimen B 19313 from the Pratt Collection is recorded as from Ben Lomond, Tasmania.

In its rather coarse ornament, this species perhaps resembles the species characteristic of the Artinskian of the Arctic, Russia, and the Himalayan regions rather than the American species ranging from the Phosphoria formation of Utah (Wolfcampian), to the Capitan limestone of Texas.

Genus Cancrinella Fredericks

Cancrinella Fredericks, 1928, pp. 784, 791; Dunbar and Condra, 1932; p. 257; Sarytcheva, 1937, pp. 78, 110.

Genotype (by original designation) *Productus cancrini* de Verneuil. The name *Productus cancrini* was first published by de Koninck (1842-4, p. 179, pl. ix, figs. 3a, b) who however made it clear that he desired to perpetuate an MS. name of de Verneuil and Keyserling, transmitted to him with a Russian Zechstein specimen so named, in a letter. While de Verneuil and Keyserling were evidently thus the suggestors of the name, the description accompanying the first publication of the name was by de Koninck, and it seems that by Article 21, de Koninck is to be regarded as the author of the name. De Koninck had before him as syntypes, this Russian specimen from the banks of the R. Kidash near Bielibei, Orenburg, unfigured, and Belgian Lower Carboniferous specimens from Visé. Of these syntypes, de Verneuil (in Murchison, de Verneuil and Keyserling 1845, p. 273), in effect chose the Russian specimen as lectotype for *P. cancrini* de Koninck, when he renamed the Viséan specimens *P. koninckianus*. He figured (pl. xvi, fig. 8a) a specimen from the R. Kidash to illustrate his restricted *P. cancrini*.

Diagnosis (after Sarytcheva): Small thin-shelled Productids with ventral valve convex and without sinus, and dorsal valve concave or slightly geniculated. Ornament of thin radial striae and concentric wrinkles, and spines, scattered on the ventral valve and always along the hinge-line and on the ears. Hinge-line without area or teeth, with cardinal process in the form of two loops on an elevated ridge on the dorsal valve. Median septum well defined.

Range—Lower Carboniferous to Upper Permian.

Remarks: Fredericks originally placed in his genus only upper Carboniferous and Permian species. Dunbar and Condra added the small U.S. Pennsylvanian *C. boonensis* (Swallow), and Sarytcheva included the Lower Carboniferous wrinkled types, about *Productus undatus* De France while presumably the unwrinkled Belgian Viséan *P. koninckianus* de Verneul (*P. spinulosus* Sowerby of de Koninck) belongs to it also. Several authors have rejected the genus and included its species under *Linoproductus,* but to me it seems a distinct and useful group. Sarytcheva notes that the earliest representatives (*C. panderi*) appear in force at the base of the Lower Carboniferous (Ufa Beds in Russia), while *C. undata* in force characterises the base of the Serpukhov horizon, these early forms differing from the later ones chiefly in their relatively poor development of spines. Netschajew (1911) has given a summary of the group in the Russian Upper Carboniferous and Permian. In the *Omphalotrochus*- and *Cora*-Beds, only C. *koninckiana.* (Keyserling non de Verneuil) occurs; in this the spine bases are fairly common and each is preceded posteriorly by a short raised and swollen part of the radial stria from which it rises, while the dorsal valve is very concave. In the *Schwagerina* horizon and later Artinskian this species is joined by *C. cancriniformis* (Tschernyschew), with similar ornament to *koninckiana* (Keyserling), but somewhat larger, with a wider hinge-line and more numerous transverse wrinklings. In the Upper Carboniferous of Greenland and Spitzbergen, these same Russian types occur. In the late Artinskian of Russia *C. cancrini,* a narrower form with more spines and fewer wrinkles, which also tend not to be continuous across the venter and whose dorsal valve is flat in the visceral disc, joins these two. In Kungurian and Kazanian times, *cancriniformis* is absent, only *C. cancrini* is common with rare *koninckiana* (Keyserling).

The spines shown in Netschajew's figures of these Permian *C. koninckiana* (Keyserling) are as in *Terrakea* prolonged anteriorly as tubes within the shell layers. Of the Russian species, our *farleyensis* is closest to *C. cancriniformis.*

In S. Persia, *C. cancriniformis* is recorded from a *Productus* zone regarded by Douglas (1936, p. 30) as equivalent to the *Omphalotrochus* beds of Russia, the Amb beds of India, and the Bolivian *"cora"* beds. In the Himalayan region and Tien Shan, the genus is fairly common, and specimens from various horizons, from the Agglomeratic Slate series to the Zewan beds, have usually been referred to the three chief species distinguished in Russia, *C. koninckiana* (Keyserling), *C. cancriniformis* and *C. cancrini,* the second (Artinskian) species being the commonest (Keidel, 1906; Diener, 1897, 1915; Reed, 1925, Merla, 1934). *C. asperula* (Waagen, 1884, p. 693, pl. LXXIX, figs. 3-6 occurs in the Middle Productus Limestone and also in Timor (Reed, 1944, p. 77). The genus is not known from Mongolia. In China, the genus appears to be poorly represented—*C. koninckiana* (Keyserling) is rare in the Taiyuan series, and *C. cancriniformis* in the cephaloped limestone (probably upper Carboniferous) and Permian ? of

Kweichow, and the *Lyttonia* sandstone near Vladivostock (Chao, 1927, 1928; Huang, 1932).

In Western Australia, *C. cancriniformis* occurs at Fossil Cliff, Irwin R., and Balmaningarra, Mt. Marmion, and *C. cancrinformis* var *lyoni* in the Lyons stage at the base of the Permo-Carboniferous sequence in the North-West Division. In Queensland and New South Wales *C. farleyensis* characterises the older parts of the marine Permo-Carboniferous sequence. The genus is not known from Tasmania.

In the U.S.A. a Pennsylvanian *Cancrinella boonensis* (Swallow) has been described by Dunbar and Condra and is a small form comparable with the European *C. koninckiana*. In the Wolfcamp correlative, the Phosphoria formation of Utah, *C. phosphatica* (Girty, 1910, pl. II, figs. 7-9) closely resembles the Russian *C. cancriniformis;* the same species (King, 1930, p. 77) extends into the Leonard and Word formations of Texas. The South American *Schwagerina*-zone species, (*C. villiersi*) is figured from the Wolfcamp (King, 1930, pl. xvii, figs. 1-2). *C. meekana* (Girty, 1908, pl. xxx, figs. 13, 13a) from the Guadalupian Delaware Mt. Formation, seems close to *C. cancrini*. Cloud (1944) has recently figured *C. rugosa* from Mexico, in strata believed equivalent to the middle Guadalupian (Word).

In Bolivia, S. America, the genus is represented by the non-geniculate *C. villiersi* in beds now regarded as equivalent to the Wolfcamp (*Schwagerina*-zone).

Some authors have attempted a sub-grouping of the forms with concentric wrinkling and pustulose spines (here placed in *Cancrinella*) according to the presence or absence of geniculation in the dorsal valve. Thus Chao regarded *C. koninckiana* (Keyserling) and *C. villiersi* as non-geniculate, and *C. cancriniformis* as geniculate. The curvature of the dorsal valve of *C. cancrini* would seem to be geniculate, but the closely related Permian *C. lahuseni* is non-geniculate.

Cancrinella farleyensis (Etheridge and Dun)

(Pl. 7, figs. 7a, b; pl. 8, figs. 1, 3a-6b.)

? *Strophomena rhomboidalis,* var. *analoga* Phill., Etheridge, 1872, pl. 16, fig. 7, Gympie.

Productus cora D'Orb; Etheridge in Jack and Etheridge, 1892, pl. 38, fig. 11, Mt. Britton Goldfield.

Productus cora var. *farleyensis* Etheridge and Dun, 1909, p. 302 pl. xlii, figs. 9, 10, 11; road cutting, Farley, near W. Maitland, N.S.W. [Farley Stage, Lower Marine Series, Kamilaroi System].

Lectotype (here chosen): That figured by Etheridge and Dun loc. cit., fig. 9; Australian Museum, Sydney, No. F 35480.

Diagnosis : Large, concavo-convex geniculate *Cancrinella* with transverse wrinkles weak over the visceral disc and trail, strong on umbonal slopes and ears and with numerous spines quincunxially arranged each issuing from the anterior end of a short raised section of a costa.

Description: The shell is usually about 34 mm. wide, 30 mm. high and 30 mm. thick, or 1 : .9 : .9, but at Homevale, Mt. Britton, Q., it is larger. The length is greater than the width, up to 55 mm., and the width of the visceral disc is equal to the width of the hinge-line. The length of the visceral disc varies, but is usually a little less than the width. The ventral valve is convex, convexity decreasing

slightly anteriorly, and the umbo is incurved over the hinge-line; the umbonal angle is 100°; and the umbonal slopes are steep and the ears wide and flat, not produced; the venter is not sinuate but has a low convexity, and the flanks are straight cardinally, curving to meet the venter.

The dorsal valve has a concave visceral disc, differentiated from the ears by a change of slope; its umbo is concave; it is geniculated to form a slightly curved trail.

Costae numerous, rounded and fine, about 24 in 10 mm. on trail, increasing by intercalation. On the ventral valve hollow spines are fairly numerous and quincunxially arranged, each issuing at the anterior end of a short raised portion of a costa. They are crowded and large on the ears. On the dorsal valve spines are absent or rare, but there are small linear depressions complementary to the raised portions of costae on the ventral valve; these show as short raised lines in the external mould of the dorsal valve. There are irregular concentric wrinkles, strongly marked on the ears and umbonal slopes, usually continuous though nearly always faintly marked across the visceral disc. A fine transverse growth lineation is present.

Internal characters: There is a slender, low median septum in the dorsal valve, and a small cardinal process; but owing to the invariable extreme thinness of the dorsal valve its characters are seldom preserved. The ventral valve is usually thin also, and thus the internal mould shows the wrinkles, costae, and short raised portions of the costae nearly as well as the external. Slight shell thickening may occur posteriorly, and the dendritic adductor muscle scars are then visible, placed posteriorly and centrally, with the striate and flabellate diductor scars forward and to the side of them. There are no teeth and no diaphragms.

Remarks: The shape of this large thin shell is much affected by crushing, and the above description is drawn up chiefly from specimens from Mt. Britton where they have not been distorted at all.

This species has the wrinkling and costation of the *Cancrinella* group rather than the *P. cora* group; all the Queensland and New South Wales specimens seem to be large and with the same proportions, and this fixity serves to distinguish them as a systematic unit. Perhaps this unit is really only a variety of *C. cancriniformis,* which it resembles fairly closely in its ornament and general shape, although the transverse wrinkling is weaker than is typical in the Russian species. In the comparative weakness of the wrinkling it resembles *C. cancrini* var. *lata* Netschajew from the Permian P_2a of Russia, but is distinguished from this by the greater length of that raised part of the costa posterior to each spine. It is close to *C. phosphatica* Girty from the Phosphoria formation of Utah, which is now correlated with the Wolfcamp (= Sakmarian or Lower Artinskian).

Distribution: Little Gorge Creek, and Cattle Creek, Springsure District, in the southern extension of the Dilly beds in the Serocold anticline; Blenheim and Black Gate, Bowen R. at an uncertain horizon; Homevale Station, Mt. Britton, in the beds with *A. springsurensis;* Cracow limestone at Cracow homestead, Dawson River; Lake's Creek quarry and vicinity at foot of Mt. Berseker, Rockhampton District, in beds with *A. springsurensis;* Yarrol Station, Burnett District; Gympie, several localities in the Middle Gympie group of Dunstan, in the Top Limestone and first or Phoenix slate, associated with *L. springsurensis.*

In New South Wales the species occurs in the type locality in the Farley Stage of the Lower Marine of the Hunter River, in the Macleay Series and the Drake Series. It is not known from Tasmania or Western Australia.

Genus Horridonia Chao

Horridonia Chao, 1927, pp. 23, 24.

Sowerbina Fredericks, 1928, p. 789, with genotype (by original designation) *Productus timanicus* Stuckenberg, 1875, p. 86, pl. 1, figs. 1-7 from the *Schwagerina* beds of Timan, which is congeneric with *P. horridus.*

Genotype (Chao, 1927, p. 23): *Productus horridus* J. de C. Sowerby. The type specimens of *P. horridus* J. de C. Sowerby, 1823, IV, p. 17, pl. cccxix, fig. 1, came (fide King, 1850, p. 91) from "the seventh bed of Mr. White Watson's first Limestone, probably Magnesian, as it is above the coal series in Derbyshire". This bed is in the Lower Magnesian Limestone. See Pl. 1, figs. 2a-c.

On p. 23, Chao stated "Finally *Pr. humboldti* d'Orb and *Pr. horridus* Sow. represent two different types of shells very distinct from all the others, for which the subgeneric names *Waagenoconcha* and *Horridonia* respectively are here introduced". On p. 24 he gave, under *Horridonia,* "Type, *Productus horridus* Sowerby and *Productus timanicus* Stuckenberg". In case it be argued that his reference on p. 23 did not make *P. horridus* Sow. the type of *Horridonia,* I here choose *Productus horridus* J. de C. Sowerby as lectotype.

Diagnosis: Shells productoid with a median sinus, smooth except for large hollow spines and faint growth lines, rarely showing traces of costation. The ventral valve is thickened posteriorly, the greatest thickening being at the muscle scars in the sinus.

From the shape of the shell, its characteristic sinus and the presence occasionally of costae, it is often assumed that *Horridonia* developed from dictyoclostids by the disappearance of ribbing and costation.

Species and their Stratigraphic occurrence: The earliest species appear to be *H. timanica,* and *H. pseudohorrida* (Wiman) which are characteristic of the upper Carboniferous rocks (*Triticites* and *Schwagerina* zones) of the Arctic regions (Grönwall, 1917, p. 602), while *H. timanica* occurs also in the Volga River bend near Samara at an unstated horizon in the *Triticites* zone or the Artinskian (Stuckenberg, 1905, p. 65). *H. timanica* has typically an extended hinge-line with long ears, a moderately highly curved ventral valve and a slightly concave dorsal valve. *H. pseudohorrida* has its widest part just anterior to the ears, which are small; it is more inrolled than *timanica;* in both species the radial spines are more obvious than the cardinal spines. In beds correlated with the *Schwagerina* zone in the Karakorum, a small species referred to *P. incisus* Schellwein by Merla (1934, pl. xx, figs. 24-26) is even more inrolled than *H. pseudohorrida,* which it somewhat resembles. Further east, in Indo-China, Mansuy (1913, pl. iii, fig. 11) records *H. timanica.* No *Horridonia* is known in China but Hayasaka (1922, p. 58, pl. 9, figs. 1-2, 9) records *H. horrida* from Japan.

The species occurring in later deposits (post Artinskian) are all distinguished by costation, weakly developed anteriorly. To this group belong the genotype, *H. horrida,* from the marl slates and lower and upper Magnesian limestones of England, east of the Pennines, and other specimens from the Rotliegende and Zechstein seas of northern Europe. This species has its cardinal spines dominant

over the radial spines, and King (1850, p. 89) remarks that different morphologies characterise different localities. The form from the Pinega Zechstein, *P. pseudohorridus* var. *pinegaensis* Licharew 1931 in Mircink (1938) is strongly inrolled, with many spines, but has an area on the pedicle valve, so that it is probably not a member of the genus *Horridonia.* In the Central American Province, *H. texana* has been founded on a single damaged pedicle valve from the Word Formation (correlated with the Kazanian by Dunbar, 1940, p. 266); it seems close to *H. timanica.* In the equivalent Delaware Mountain Formation and the higher Capitan limestone, a group of five species discussed by Girty (1908, p. 233) resemble late *Horridonia,* in the development of costae; ribbing also may be developed posteriorly. Some *Marginifera* tend towards *Horridonia* in external form and ornament, and a more precise knowledge of the internal characters of the smooth forms is desirable. No diaphragm or marginal ridge is yet known in any of the species referred above to *Horridonia.*

Horridonia mitis sp. nov.

(Pl. 8, figs. 7-10b, pl. 9, fig. 1)

Holotype: F 10772 University of Queensland Collection, from white limestone, in the Ridge ¼-½ mile west by north of Cracow homestead near the base of the marine Kamilaroi there. Material studied was about 60 damaged specimens usually showing the ventral valve only.

Diagnosis: Highly inrolled *Horridonia* with steep umbonal slopes and nearly parallel-sided sinus; the radial spines are dominant over the cardinal spines, but are sparse, and no costae are developed.

External Form: The shell is concavo-convex; the convexity of the ventral valve is great, and as the shell lies in the position of rest on its ventral valve the hinge-line appears midway between the umbonal shoulders and the upturned skirts, and the profile normal to the hinge-line is a stout ellipse, with its shorter axis vertical; the hinge-line lies three-quarters of the way up this vertical axis. There are small ears at the end of the hinge-line, which represent the greatest width of the shell, and the umbonal slopes are very steep. The median sinus is moderately deep and is not noticeably expanded anteriorly.

Dimensions of holotype: Width of hinge-line (incomplete, ears slightly damaged) 28 mm. Distance between umbonal shoulders and skirts, 28 mm. Distance from resting surface to umbonal crest 20 mm. Distance from hinge-line to umbonal crest 5 mm. Distance from ridge to ridge over sinus, 6 to 8 mm. The average specimen is slightly smaller than the holotype.

Ornament. There are two to five not very regular series of distant, large, hollow spines developed on each side of the mid line; usually the series are from 2 to 5 mm. apart, and the spines in each series about 3 mm. apart near the hinge-line, but more distant anteriorly. Other radial ornament is lacking with the exception of occasional low ill-defined ridges or even folds extending along a spine series or close to it. Irregularly spaced faint transverse striation is noted on perfect outer surfaces, diverted posteriorly in the vicinity of spines.

Dorsal Valve: None of my specimens shows enough of the dorsal valve for description.

Internal Structure (from thin sections only; no moulds are available): The ventral valve is much thickened just behind the umbo, and this thickening grad-

ually increases anteriorly for some distance; the area just below the median sinus is by far the most thickened, but there is a certain lateral spread also. The thickening dies away anteriorly very much more rapidly than it increased.

Observations: This species resembles *H. pseudohorrida* Wiman from the Upper Carboniferous of the Arctic regions (See p. 16). It differs in the much greater curvature of the ventral valve, and in the great parallelism of the folds bounding the sinus. It also bears resemblance to *H. incisa* (Schellwein of Merla 1934), from beds in the Karakorum, correlated with the Artinskian (Sakmarian) *Schwagerina* zone, but is larger and more inrolled.

The Cracow specimens are mostly dissociated ventral valves with their spines broken off; they are associated in a band of limestone in which they are crowded, with a small *Streptorhynchus*. In its general character the species resembles the Upper Carboniferous (*Schwagerina* zone and upper Artinskian) rather than the Permian (Magnesian Limestone) forms.

Genus Terrakea Booker

Terrakea Booker, 1930, p. 66.

Genotype (by original designation): "*Terrakea brachythaera* G. B. Sowerby, 1844 (sp.)." Booker had not seen Sowerby's syntypes, which were unfigured, and following Etheridge and Dun (1909) and other Australian authors he interpreted *brachythaerus* on Morris, 1845, pl. xiv, fig. 4c. But the only syntype of *P. brachythaerus* Sowerby now extant (B.M. B.19298) is a species of *Strophalosia,* and to have *P. brachythaerus* Sowerby as type of *Terrakea* would shelve this name in the synonymy of *Strophalosia* and make a new generic name necessary for the group about *P. brachythaerus* Morris, 1845, pl. xiv, fig. 4c non Sowerby, 1844. I am in correspondence with the International Commission for Biological Nomenclature on this matter, and pending its results I use *Terrakea* in Booker's sense for species congeneric with *P. brachythaerus* Morris fig. 4c non Sowerby.

Diagnosis: Shell productoid, plano- or concavo-convex and geniculate without median sinus or fold; greatest width a little anterior to the hinge-line, umbo overhanging hinge, visceral disc triangular, somewhat flattened ventrally, widening regularly forward from the umbo, with tall steep umbonal slopes; ears wide and flattened, with wrinklings and crowded, large, tubular spines; area and teeth absent. Ornament of ventral valve, very fine radial striation and occasional transverse striation with coarser decurrent spines whose bases are in thin tubes forming short radial ridges on the inner surface of the valve.

Muscle scars productiform, dendritic. Cardinal process bilobed, continued from a low, narrow median septum. Brachial ridges delicate, productoid.

Remarks: The anterior prolongation within the shell layers of the tubules of the spines, and the flattening of the venter are characteristics of this genus. It is known with certainty only in the Permo-Carboniferous of Eastern Australia, where it ranges throughout, being present from the Dilly Beds of the Springsure area to the *Productus* Bed of Mantuan Downs. Of foreign species which may possibly belong to it, the most likely is *Cancrinella koninckiana* (Keyserling, of Netschajew, pl. iii, figs. 8, 9) from the Zechstein, (P_2b) of the Ufa district, which shows the characteristic ornament, but the venter is highly arched, not flattened.

Australian species are *T. pollex* nov. described below from the lowest marine Kamilaroi in Queensland; *T. fragilis* Dana and the closely similar if not identical

P. brachythaerus Morris fig. 4c only, from the Illawarra district of N.S.W. (upper marine); *T. solidus* Etheridge and Dun from [the highest marine bed, the Mantuan Downs Productus bed of]the Don? R. and of the Springsure district, Q., a closely similar form from Point Puer near Port Arthur Tasmania (Morris pl. xiv, figs. 4a, b) and *T. levis* Booker (1930, p. 70, pl. ii, figs. 3, 4) from the Upper Marine of the Hunter R. and Southern Coalfields of N.S.W. Revision of these species is not undertaken herein; they are all distinctly broader than the narrow, thumb-like *T. pollex* described below.

Note on Productus brachythaerus Sowerby 1844, p. 158

This species was based on three specimens collected by Darwin from "the southern part of Tasmania". Sowerby did not figure the species, but defined it as follows:—

"Producta, testa subtrapeziforma, compressa, parte antica latiori, sub-biloba, postica angustiori, linea cardinali brevi." The first and third of the specimens mentioned by Sowerby are lost, but the conclusion that the British Museum (Natural History) specimen B. 19298 which I have studied and whose photograph is reproduced herein (Pl. 1, fig. 3) is the second specimen mentioned by Sowerby seems to me inescapable, for the following reasons:

(1) It exactly fits the Latin description given by Sowerby, especially "linea cardinali brevi", whereas the hinge-line of the specimens Morris (1845) figured as belonging to this species is long.

(2) Its appearance is exactly that described by Sowerby for his second syntype "another specimen, which I suppose to be an impression of the inside of the flat valve, is in stone, of a light, rusty brown colour".

(3) It bears the printed number "498" in an unusual type, characteristic of that used to number the Darwin collection of Tertiary fossils from S. America figured in Darwin's "Volcanic Islands".

(4) It is labelled in writing which appears identical with the authentic script of G. B. Sowerby, *"Productus brachythaerus,* inside of flat valve".

(5) It is a very common species in the vicinity of Hobart where Darwin spent his stay in Tasmania.

(6) Sowerby described only two productoids from Tasmania, and the first of these, *P. rugata* Phillips could not conceivably have been intended for this specimen.

It seems then, that *Productus brachythaerus* Sowerby must be interpreted on this specimen, which is however a *Strophalosia,* with the characteristic teeth and muscle scars of that genus. When Sowerby wrote, *Strophalosia* King 1846 had not been split from *Productus.*

Notes on Productus brachythaerus Morris 1845 non Sowerby 1844

(Pl. 2, figs. 1, 2a-d)

Morris in 1845 described and figured under the name *Productus brachythaerus* Sowerby two species of productinids, one from Illawarra [on the southern coalfield of] N.S.W., which he figured on pl. xiv, fig. 4c and which is refigured herein pl. 2, fig. 1, and the other from [Point Puer near Port Arthur] Tasmania which he figured on pl. xiv, fig. 4a, b and which is refigured herein pl. 2, figs. 2a-d.

Neither is congeneric with the strophalosiinid second syntype of Sowerby's *P. brachythaerus,* the only one now extant, but both have the generic morphology implied by *Terrakea* Booker. The first, British Museum specimen 96873a could well be *Productus fragilis* Dana (1849, p. 686, pl. 2, fig. 7), which Dana described from Illawarra, while the second, British Museum specimen 96873b, to which Etheridge in Etheridge and Dun (1909, p. 302) has given an MS. name, is close to *Productus solidus* Etheridge and Dun 1909 (p. 303, pl. xliii, figs. 1-4) from the Darr (Don ?) R., Queensland. Etheridge and Dun (1909) and later authors have interpreted *P. brachythaerus* on fig. 4c of Morris.

Terrakea pollex sp. nov.

(Pl. 9, figs. 6-12)

Holotype: F. 10758, University of Queensland collection $\frac{1}{4}$-$\frac{1}{2}$ mile N.W. of Cracow Homestead, near the base of the marine sequence of Kamilaroi exposed in the Cracow district; associated with *Lissochonetes* sp. nov. and a small gastropod. Additional material used in description, 31 specimens from the same locality and horizon.

Diagnosis: Small, elongate, concavo-convex *Terrakea,* with geniculate dorsal valve; slightly narrower at hinge-line than anteriorly; umbonal angle obtuse, visceral disc widening rapidly at first, and but very slightly anteriorly; curvature across disc a little less than that along it; no callosity in ventral valve. Ornament typical of genus.

Description: The shell is concavo-convex, the dorsal valve usually becoming geniculate; it is narrow, the average measurement being 22 mm. at the hinge-line and 24 mm. at the anterior margin; and elongate, the overall length of the shell from the hinge-line over the umbo and the visceral disc to the end of the trail being 60 mm.; the curvature along this line is great at first but decreases gradually anteriorly; the length along the base of the trail, between anterior margin and hinge is 20 mm., and between hinge and outer curve of visceral disc, 10 mm. The trail in the dorsal valve is 25 mm. long, and the visceral disc 7 or 8 mm. deep. The umbo considerably overhangs the hinge-line and the umbonal angle is at first more than a right angle; the umbonal shoulders are steep at first, gradually merging into the visceral disc. The visceral disc is less highly arched across its length than on it, and this flattening is more marked on the trail. The dorsal valve is slightly concave in the visceral disc and bends sharply to give a trail 25 mm. long in the average shell.

The ornament is that characteristic of the genus. There is a fine radial striation, 10 or 11 striae in 5 mm. Spines are large and tubular, and arranged in radial series; the spines in each radial series are often about 10 mm. apart on the visceral disc; neighbouring series are about 1 mm. apart, and the spines of one series are arranged en echelon with those of its neighbours. The resulting pattern is somewhat irregular. The spines are crowded on the ears, and are far more numerous on the trail than on the disc, especially in the dorsal valve, where few if any spines are developed on the disc. On the ears the spines are usually at right angles to the shell. On the disc the spines issue at right angles, but rapidly turn to a course more or less parallel to the shell; on the trail the spines tend to remain at right angles to the shell layers. Often there is a raised radial ridge 1 or 2 mm. long on the outer surface of the shell, posterior to the point of issue of the spine.

The hollow tubes are continued forward within the shell layers from the point of issue of the spine, for greater or less distances, and a characteristic feature of the genus is the arching of the inner layers of shell about this anterior prolongation of the spine tube, so that the internal mould of the shell shows radial furrows, of variable length.

Internal, ventral valve: The internal moulds of the ventral valve show that there is no shell callosity developed in the umbonal regions in this species; muscle markings are faint and productoid. Short radial grooves on the mould indicate the presence of the tubules buried in the shell anterior to the point of issue of the spine.

Internal, dorsal valve: The cardinal process is produced into the umbo of the ventral valve, in the plane of the dorsal valve; it is bifid, and may be quadrifid. A median septum is present and extends at least half the length of the visceral disc, and may be longer, only imperfect specimens having been studied as yet.

Remarks: Nearly all the specimens of *Terrakea* known from the lowest Permo-Carboniferous marine beds of Queensland are narrow, not more than 23-24 mm. wide, in contrast to the generally greater width at higher horizons. This narrowness, together with the smaller degree of flattening of the visceral disc in the ventral valve, forms the specific distinction between *pollex* and the later forms of *Terrakea.*

This species is known from the Dilly Beds of Dilly; from the southern extension of these beds in the Serocold anticline; from the beds with *springsurensis* at Homevale; Mt. Britton; North of Granite Ck., Wilangi, Styx R.; and Stoodleigh Station, Styx R.. It has not yet been found in the more closely folded region to the east of the Bowen syncline and its southern continuation.

Genus Krotovia Fredericks

Krotovia Fredericks, 1928, p. 790; Dunbar and Condra, 1932, p. 211; Prendergast, 1943, p. 29.

Genotype: *Productus spinulosus* J. Sowerby (1814, p. 155, pl. lxviii, fig. 3); Carboniferous Limestone, West Lothian, Linlithgowshire, Scotland.

Diagnosis: Small, smooth, spinose, non-sinuate Productids, with concave or geniculate dorsal valve, and without cardinal area.

Range: Dinantian to Upper Artinskian.

? Krotovia sp.

Material: Five specimens collected by A. K. Denmead from the ridge ¼-½ mile west by north of Cracow homestead, Dawson Valley, near the base of the marine Kamilaroi exposed in the district.

Description: The shells are all incomplete ventral valves, broken anteriorly and with the cardinal margin hidden or broken. As far as can be ascertained, an area is not present. They are concavo-convex (seen from sections), and somewhat transverse; hinge-line in largest specimen 40 mm.; in smallest 18 mm.; incomplete length of largest specimen, 48 mm. The ventral valve is broadly convex with the umbo overhanging the hinge, and is non-sinuate, the venter being shallowly convex; the visceral disc merges into the flanks, and the umbonal slopes are marked from the ears by a gentle change of slope only. The ornament is of concentric, rather marked growth lineation only, and scattered fine spines; there are no radial

costae or lineation on the outer shell layer, but inner shell layers show a fine radial pattern owing to the prismatic constitution; the concentric growth lineation indicates that the shell was transverse, with the greatest width at the hinge-line.

Remarks: Since it is not proved that area and teeth are absent, the generic position of this form is uncertain. The above brief description is included in the hope that it will encourage search for more material. I failed to find more specimens on my visit to Cracow in 1947.

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EXPLANATION TO PLATES

PLATE 1.

All figures natural size. British Museum Photographs by Courtesy of Dr. H. Muir-Wood.

Fig. 1. *Aulosteges* (*Taeniothaerus*) *subquadratus* (Morris). Lectotype, British Museum 91171 [Mt. Wellington or Mt. Dromedary] Tasmania. [? Granton substage of Cascades Stage of Lower Marine Series, Kamilaroi System, Permo-Carboniferous]. Specimen partly decorticated. 1a, mid ventral view; 1b, posterior view; 1c profile seen from side.

Fig. 2. *Horridonia horrida* (J. de C. Sowerby). Type (British Museum B 60972) figured King, 1850, pl. xi. fig. 2, and J. de C. Sowerby, 1923, pl. cccxix. fig. 1, from (fide King, p. 91) "the seventh bed of Mr. White Watson's first Limestone, probably Magnesian, as it is above the coal series in Derbyshire" Dr. C. J. Stubblefield informs me that this bed is in the Lower Magnesian Limestone. 2a, posterior view; 2b lateral view; 2c mid ventral view.

Fig. 3. *Productus brachythaerus* Sowerby 1844, only syntype extant. British Museum B 19298 from [the southern part of] Tasmania. Permo-Carboniferous. Internal mould of dorsal valve and umbonal region of ventral valve.

PLATE 2.

All figures natural size. Figs. 1, 2a-d from British Museum photographs by courtesy Dr. H. Muir-Wood. Remainder photographed by Mr. B. Whelan, University of Queensland.

Fig. 1. *Productus brachythaerus* Morris, 1845, fig. 4c only non Sowerby, 1844. British Museum BB 9466. Ventral view of internal mould of visceral disc. From Illawarra or Raymond Terrace, N.S.W. Permo-Carboniferous. This is *Terrakea* sp., possibly *fragilis* Dana 1849.

Fig. 2. *Productus brachythaerus* Morris 1845 figs. 4a, b, only non Sowerby 1844. British Museum BB 9467. Internal mould. From [Point Puer near Port Arthur] Tasmania. Permo-Carboniferous. 2a posterior view; 2b lateral view; 2c dorsal view showing dendritic muscle scars and median septum; 2d ventral view.

Fig. 3. *Aulosteges (Taeniothaerus) subquadratus var. acanthophorus* (Fletcher). Holotype. F. 10747. University of Queensland, Coll. J. H. Reid 153 Little Gorge Ck., Springsure District, Queensland. Southern extension of Dilly Beds, exposed in Serocold Anticline. 3a dorsal view; 3b ventral view; 3c lateral view, showing short trail.

Fig. 4. The same. Geol. Survey of Queensland F. 1994, Little Gorge Ck. B, Springsure District, same horizon. Lateral view showing fringe of spines on the short trail.

Fig. 5. The same. Geol. Survey of Queensland F. 1995, Consuelo Ck., 2 miles above Cattle Ck., Springsure. Same Horizon. Part of cardinal region; 5a showing an area; 5b from inside showing cardinal process forming a cross with a roll of thickening along the hinge of the ventral valve.

Fig. 6. The same. Geol Surv. of Queensland F. 1996. Same locality and horizon as fig. 5. The trifid cardinal process; 6a viewed from ventral valve; 6b lateral view.

Plate 3.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Aulosteges (Taeniothaerus) subquadratus* var *cracowensis* var. nov. Holotype F. 10741 University of Queensland. Ridge ¼-½ mile west by north of Cracow homestead, Dawson Valley. Lowest marine Permo-Carboniferous. Note the narrow hinge, the heavy umbonal shoulders and the very long trail. 1a dorsal view; 1b anterior ventral view of trail. See also Pl. 4, figs. 1a, 1b.

Fig. 2. The same. F. 10738, University of Queensland, from same locality and horizon. A younger specimen, showing the long trail.

Fig. 3. The same. F 10739, University of Queensland, from same locality and horizon, showing the relatively coarse ornament of the variety.

Plate 4.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Aulosteges (Taeniothaerus) subquadratus, var. cracowensis* var. nov, Holotype F. 10741 University of Queensland from ridge ¼-½ mile west by north of Cracow homestead Dawson Valley; base of marine Permo-Carboniferous. 1a ventral view showing shallow sinus; 1b lateral view showing long skirts with radial ribs. See also pl. 3, figs. 1a, b.

Fig. 2. The same. F. 10744 University of Queensland from same locality and horizon. Median section, showing inclination of cardinal process and crushing characteristic of locality.

Fig. 3. The same. F. 10743 University of Queensland from same locality and horizon. Internal mould. 3a lateral view; 3b dorsal view showing dendritic muscle scars; 3c ventral view showing muscle scars.

Plate 5.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Aulosteges (Taeniothaerus) subquadratus* (Morris). F 10746 University of Queensland. Internal mould of thin shelled specimen. Mt. Britton, in beds with *A. springsurensis*. 1a ventral view; 1b dorsal view showing dendritic muscle scars, median septum and cardinal process; 1c lateral view showing profile of visceral disc.

Fig. 2. The same F 10745 University of Queensland from same locality and horizon. External mould of dorsal valve; 2a median view; 2b lateral view, showing short trail.

Plate 6.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Aulosteges randsi* sp. nov. Holotype Geol. Surv. Queensland. F. 1991; W. H. Rands Coll. North of Granite Ck., Wilangi, Styx R., St. Lawrence district; in beds with *T. pollex* Permo-Carboniferous. 1a, ventral view of F 1991a, internal mould, showing twisting and crumpling of thin shell: 1b lateral view of F 1991a; 1c dorsal view of area on internal mould of ventral valve. F 1991a; 1d F 1991b, external mould of ventral valve, counterpart of specimen F 1991a, same locality and horizon, showing coarse spines.

Fig. 2. *Aulosteges* (*Taeniothaerus*) *subquadratus* var. *cracowensis* var. nov. F 10737 University of Queensland. Lateral view of natural median section of visceral disc portion of ventral valve, showing great thickness. Same locality and horizon as Pl. 4, figs. 1a, b.

Fig. 3. The same. F 10742 University of Queensland. Same locality and horizon. External mould of cardinal region. Compare area with that of Pl. 2, fig. 5a.

Fig. 4. *Aulosteges* (*Taeniothaerus*) *subquadratus* (Morris). F 1993 Geol. Surv. Queensland, Lake's Ck., (Suite 4) Rockhampton in beds with *A. springsurensis*, Permo-Carboniferous. External mould of cardinal region, internal of ventral valve. Note wide hinge-line and distortion.

Plate 7.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Anidanthus springsurensis* (Booker) F 2004 Geol. Surv. Queensland. Lake's Ck. (Suite 4), Rockhampton. Permo-Carboniferous.

Fig. 2. The same. F 2003 Geol. Surv. Queensland. Upper Cattle Ck., Springsure. Southern extension of Dilly Beds, exposed in Serocold anticline. Permo-Carboniferous. 2a lateral view; 2b ventral view of ventral valve, showing coarse radial striae.

Fig. 3. The same. F 10770 University of Queensland Collection. Fossil Ridge, Mt. Britton. Permo-Carboniferous. External mould of dorsal valve; 3a showing concentric ornament; 3b lateral view.

Fig. 4. The same F 10768 University of Queensland Collection. Same locality and horizon; internal mould of ventral valve; 4a lateral view; 4b ventral view.

Fig. 5. The same F 10760 University of Queensland Collection; bed immediately above limestone, fossil ridge ¼-½ mile west by north of Cracow homestead, Dawson Valley; near base of marine Permo-Carboniferous there; internal mould of ventral valve; 5a lateral view; 5b ventral valve.

Fig. 6. The same F 10764 University of Queensland Collection; same locality and horizon; external mould of dorsal valve, showing ears.

Fig. 7. *Cancrinella farleyensis* (Etheridge and Dun). F 10763 same locality and horizon; external mould of dorsal valve.

Plate 8.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Cancrinella farleyensis* (Etheridge and Dun). F. 10765 University of Queensland, Fossil ridge Mt. Britton; in beds with *A. springsurensis?* Permo-Carboniferous; external mould of ventral valve.

Fig. 2. The same. F 1999 Geol. Surv. Q'ld. Little Gorge Ck. A, Springsure District. Southern extension of Dilly beds, exposed in Serocold anticline. External mould of dorsal valve; 2a ventral view; 2b lateral view.

Fig. 3. The same. F 2000 Geol. Surv. Q'ld. Same locality and horizon. External of ventral valve; 3a ventral view; 3b lateral view.

Fig. 4. The same. F 1998 Geol. Surv. Q'ld. Richards; 3 miles S.W. of Mt. Britton Township; in beds with *A. springsurensis* Permo-Carboniferous; internal mould of ventral valve; 4a ventral view; 4b lateral view.

Fig. 5. The same. F 2005 Geol. Surv. Q'ld. Lake's Ck. (Suite 3) near Rockhampton, in beds with *A. springsurensis* near base of Permo-Carboniferous. Internal mould, dorsal view.

Fig. 6. The same. F 1997 Geol. Surv. Q'ld., same locality and horizon as fig. 4; external mould, dorsal valve; 6a ventral view of visceral disc portion; 6b lateral view.

Fig. 7. *Horridonia mitis* nov. Holotype F 10772 Univ. Q'ld. Limestone in Fossil ridge ¼-½ mile west by north of Cracow homestead, Dawson Valley; near base of marine Permo-Carboniferous; 7a, dorsal view; 7b ventral view; 7c lateral view.

Fig. 8. The same. F 10775 Univ. Q'ld. Same locality and horizon. Median section showing sharp thickening of shell in region of muscle scars. Similar thickening occurs in the genotype.

Fig. 9. The same. F 10773 Univ. Q'ld. Same locality and horizon; 9a ventral view; 9b lateral view.

Fig. 10. The same. F 10774 Univ. Q'ld. Same locality and horizon; 10a ventral view; 10b lateral view.

Plate 9.

All figures natural size, photographs by Mr. B. Whelan.

Fig. 1. *Horridonia mitis* sp. nov. and *Streptorhynchus* sp. F 10776, Univ. Q'ld. Coll. Same locality and horizon as Figs. 7-10, Pl. 8.

Fig. 2. ? *Krotovia* sp. F 10750 Univ. Qld. Cracow, near base of marine Permo-Carboniferous; ventral valve; 2a posterior ventral view; 2b median ventral view; 2c posterior view; 2d lateral view.

Fig. 3. The same. F 10748 Univ. Q'ld. Same locality and horizon; ventral valve; ventral view.

Fig. 4. The same. F 10751 Univ. Qld. Same locality and horizon; ventral valve of young shell; ventral view.

Fig. 5. The same. F 10749 Univ. Q'ld. Same locality and horizon. Median section; showing the concave dorsal valve parallel to the convex ventral valve.

Fig. 6. *Terrakea pollex* sp. nov. Holotype. F 10758 Univ. Q'ld. Fossil Ridge ¼-½ mile west by north of Cracow homestead, Dawson Valley; base of marine Permo-Carboniferous; ventral valve; 6a ventral view; 6b lateral view.

Fig. 7. The same. F 10754 Univ. Q'ld. Same locality and horizon; 7a ventral view; 7b lateral view.

Fig. 8. The same. F 10752 Univ. Q'ld. Same locality and horizon; 8a ventral view, note median flattening; 8b lateral view.

Fig. 9. The same. F 2001. Geol. Surv. Q'ld. Little Gorge Ck. A. springsure District, Southern extension of Dilly Beds, in Serocold Anticline. Partly decorticated dorsal valve.

Fig. 10. The same. F 2002. Geol. Surv. Q'ld Cattle Ck., Springsure District. Same horizon as Fig. 9; 10a ventral view; 10b lateral view.

Fig. 11. The same. F 10757 Univ. Q'ld. Same locality and horizon as Figs. 6-8, this plate; internal mould of ventral valve; 11a ventral view; 11b dorsal view.

Fig. 12. The same. F 10756. Univ. Q'ld. Same locality and horizon. Median section showing geniculation of dorsal valve.

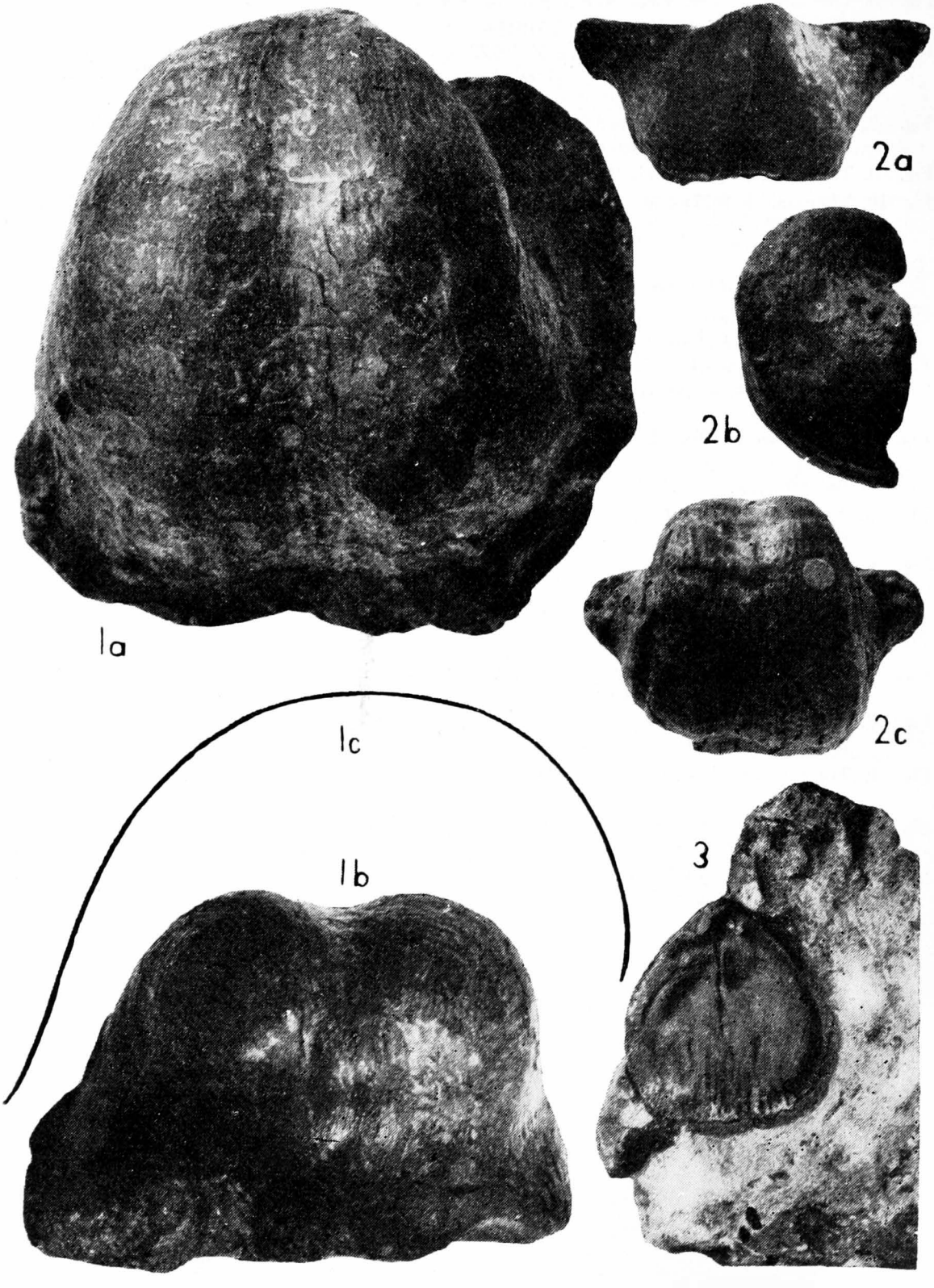
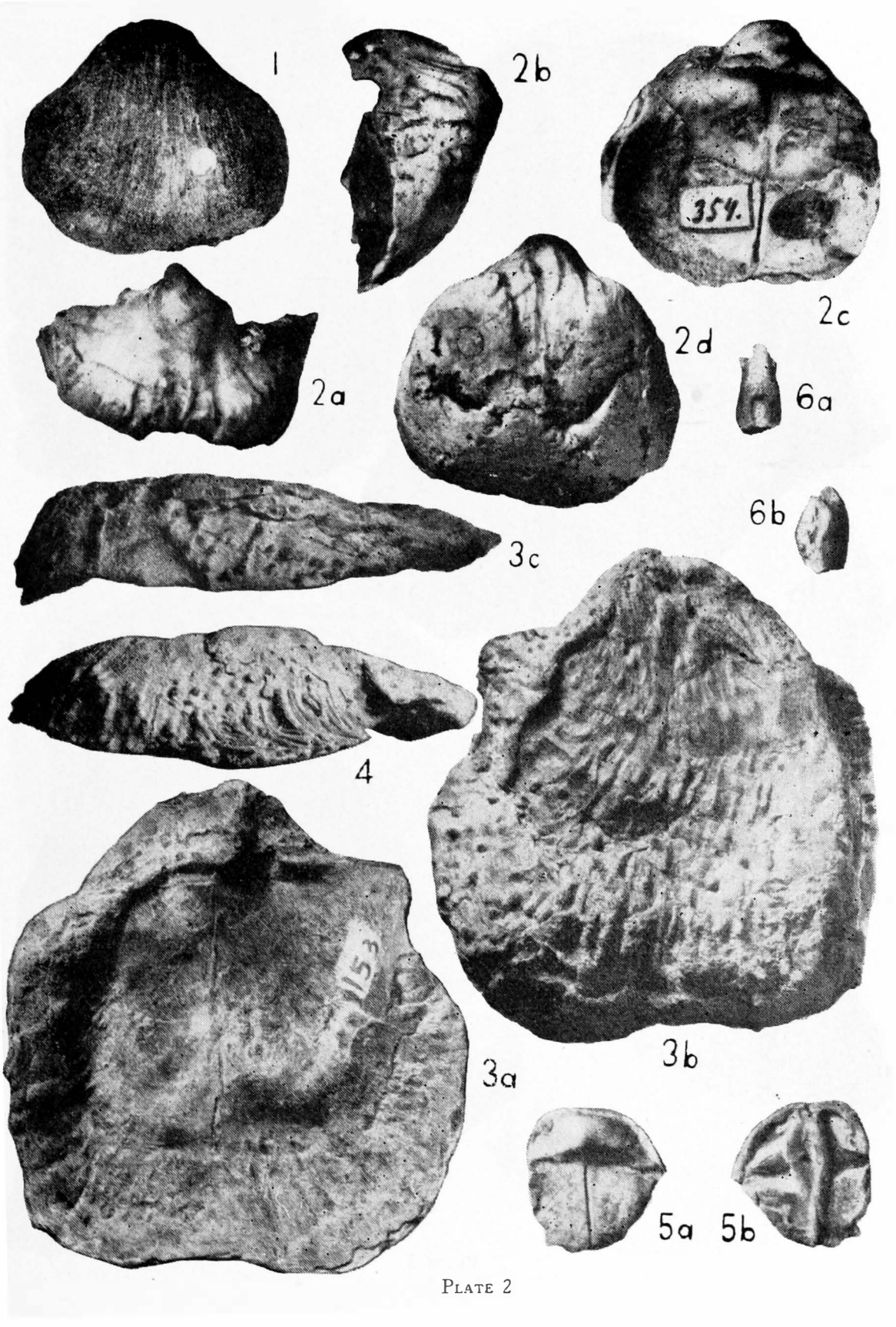


PLATE 1



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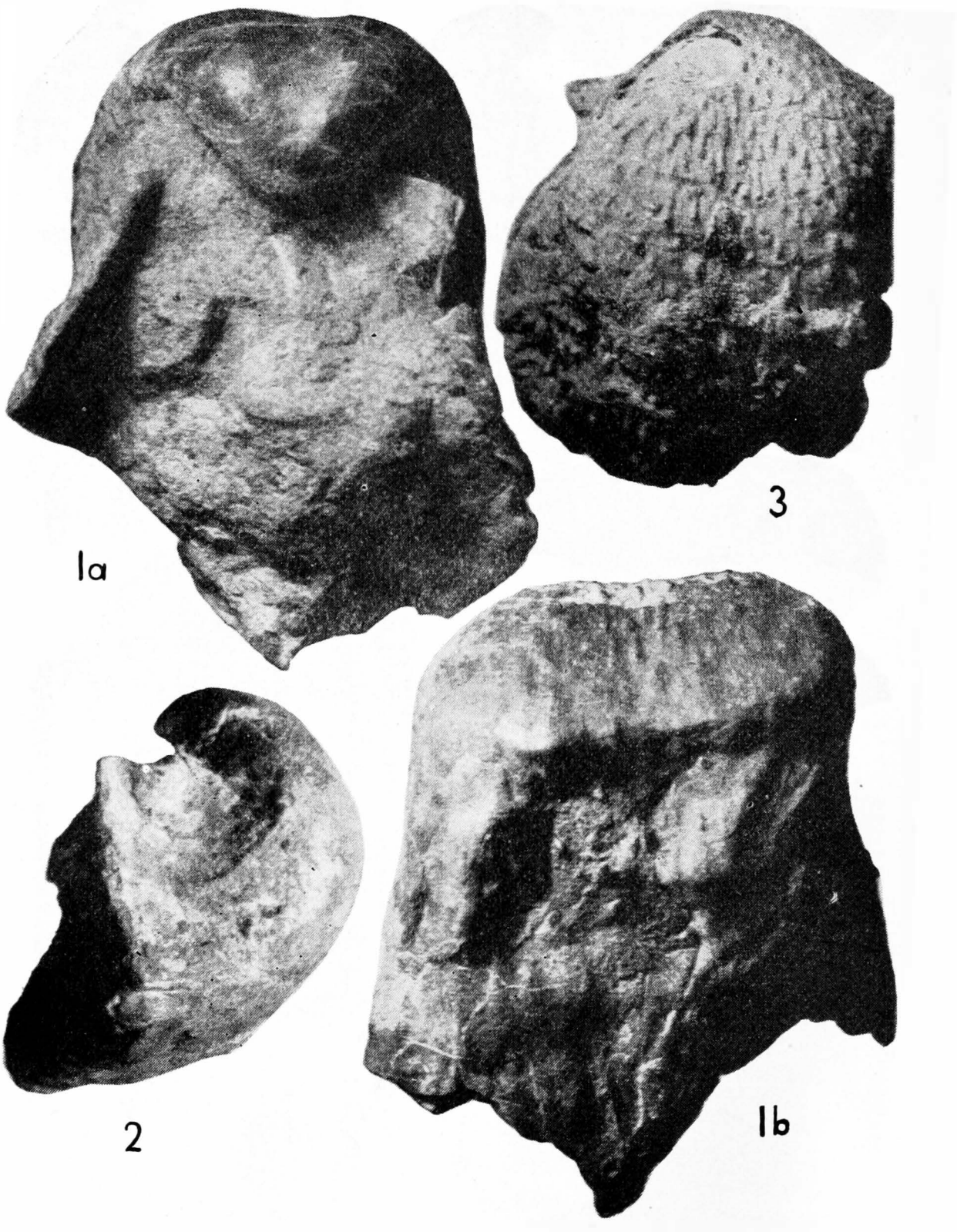

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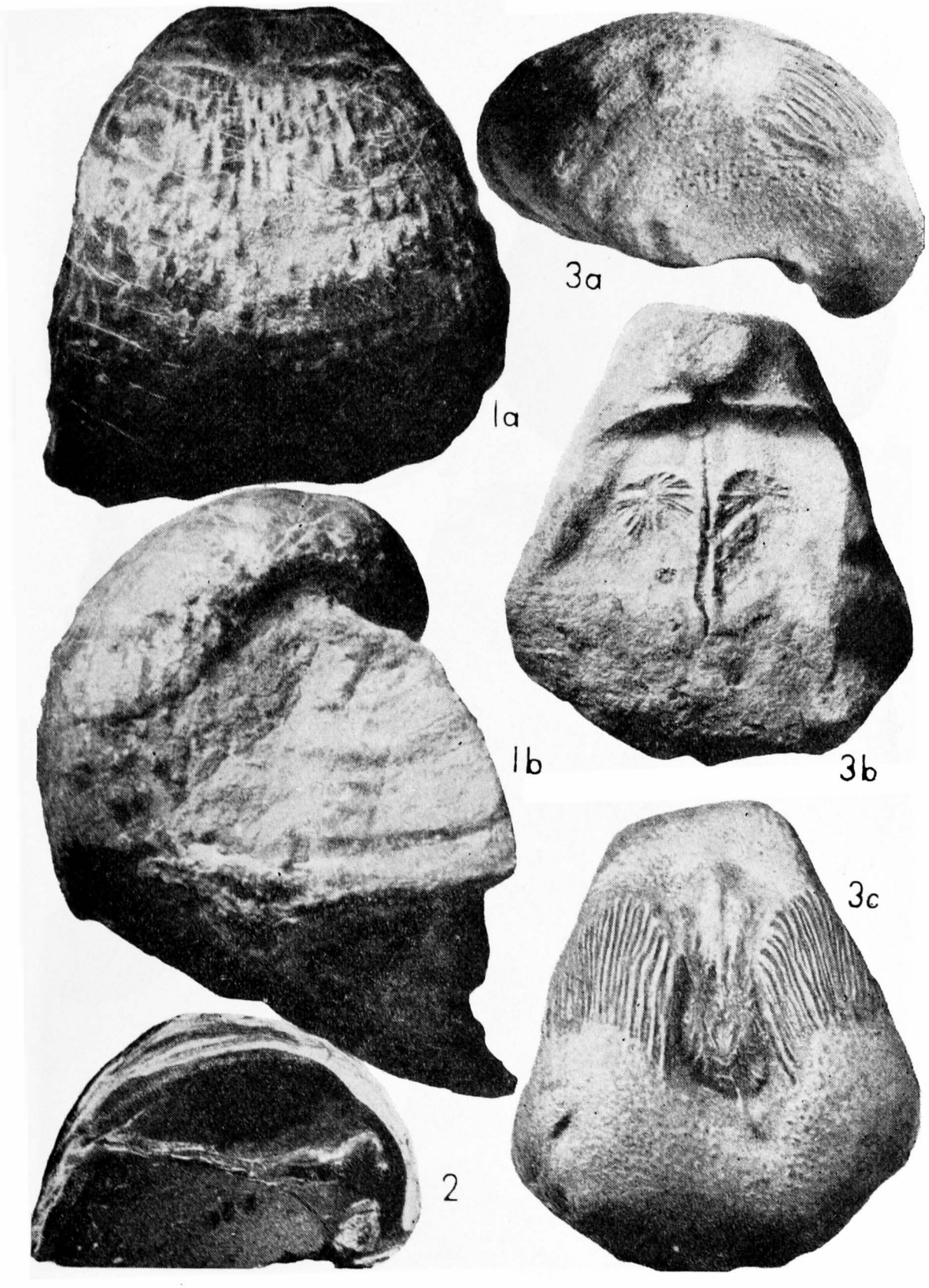
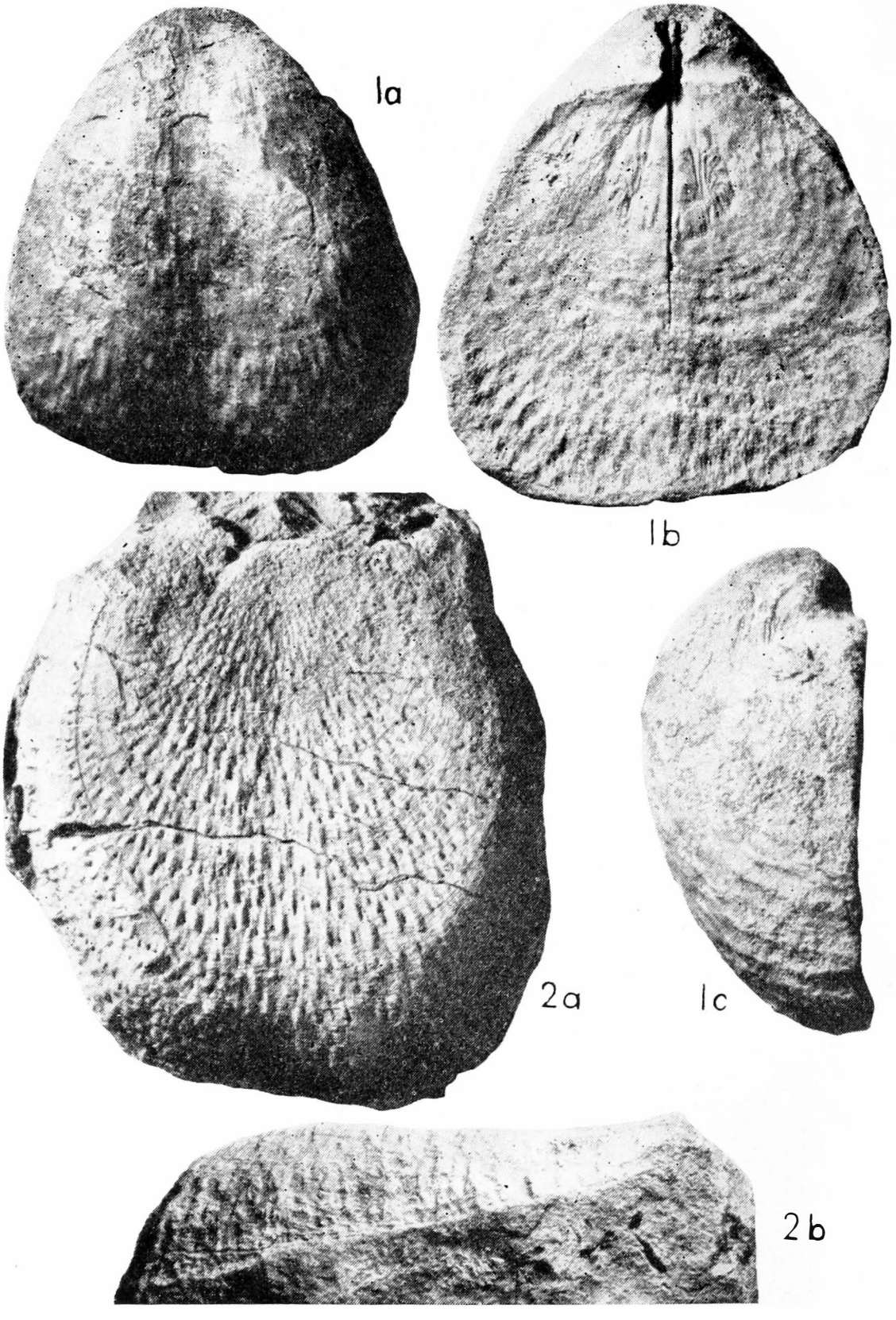


PLATE 4



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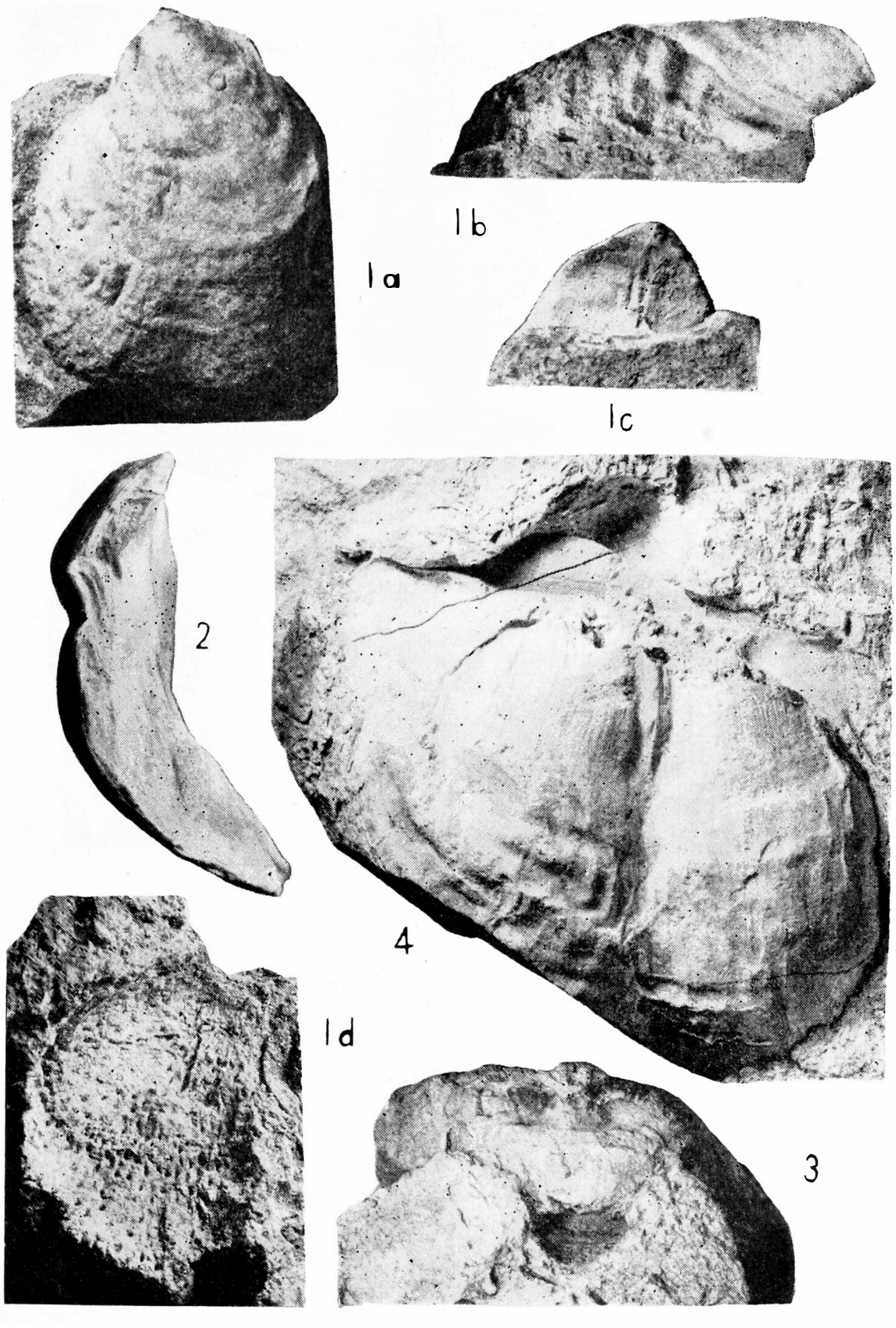

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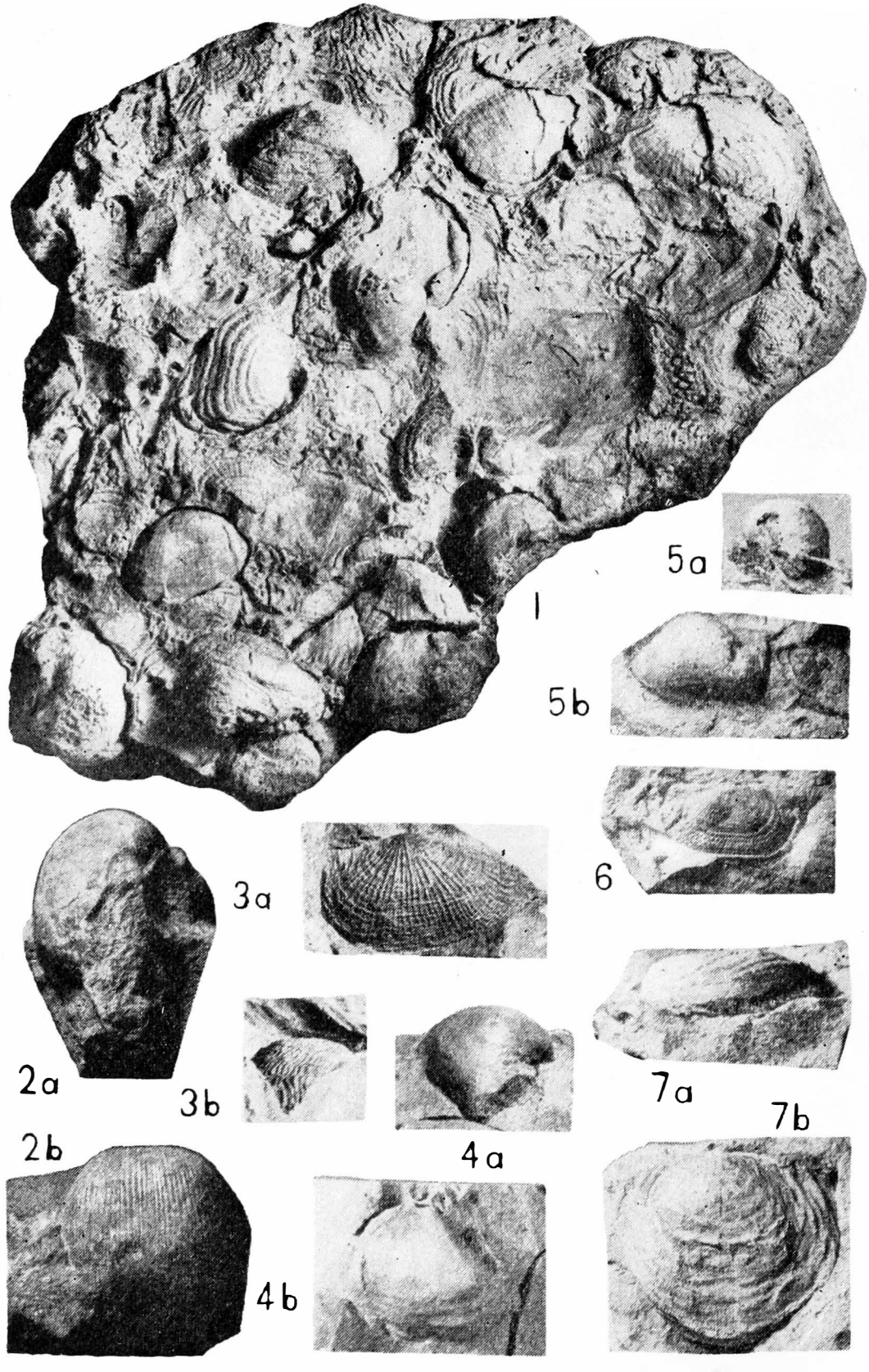

PLATE 7

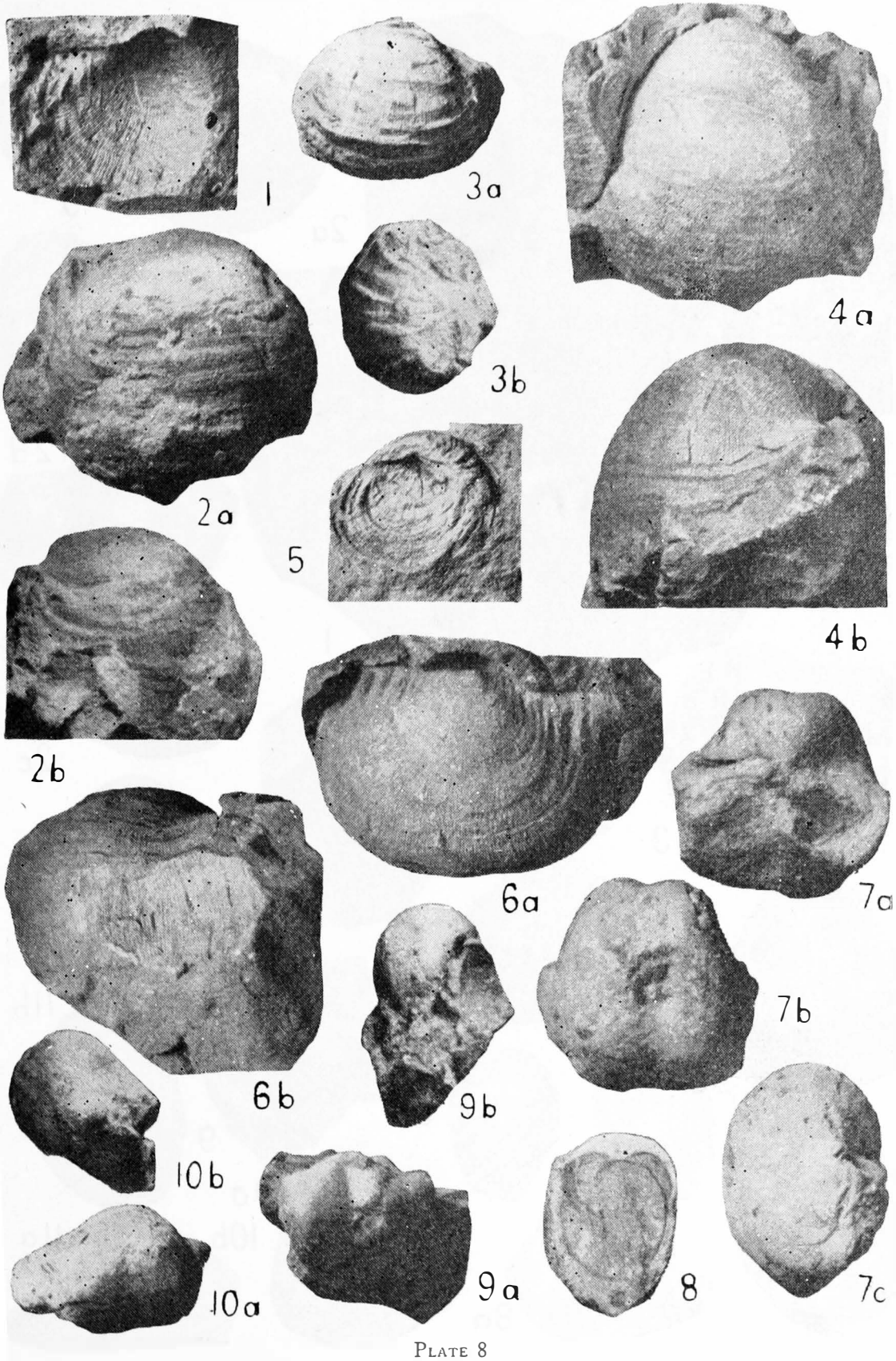

PLATE 8

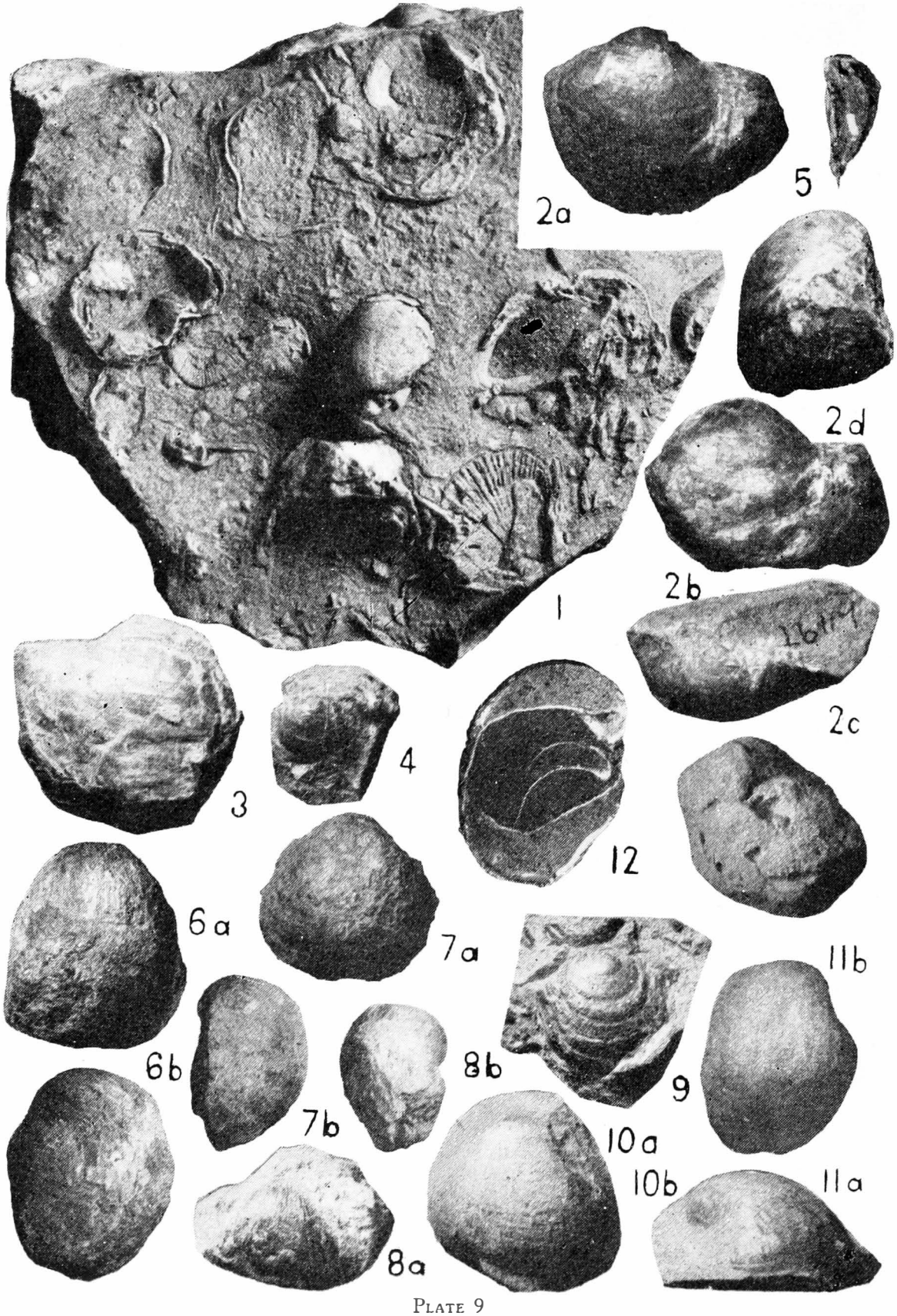

PLATE 9